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THE HISTORY AND TREATMENT OF JAW FRACTURES FROM WORLD WAR I TO WORLD WAR II

Collective Review

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IT was World War I which brought about the very urgent need for more efficient treatment of fractures of the jaws. At no previous time had so many and so badly comminuted fractures been encountered. With the first World War there began an epoch in which the treatment of jaw fractures and associated wounds was placed on an entirely new basis. In World War II, the former experience with these injuries and the new methods developed in the interim should be of great aid to the surgeon.

THE TREATMENT OF FRACTURES DURING WORLD WAR I

One of the features of World War I was trench warfare, as a consequence of which, the upper part of the body was chiefly exposed to injury, particularly the head and face. This, combined with the destructive effect of high explosives and bullets, shells, and hand grenades, caused comminuted compound fractures and mutilated faces in many of the casualties, such as had been rarely seen before. The surgical skill and mechanical ingenuity of those who served with the armed forces was put to a test. Since the shattered jaws and lacerated skin, if not properly treated, not only cause inability to masticate food properly but result in disfigurement, the surgeon had to develop new methods to improve the treatment of fractures, and plastic operations to enhance the cosmetic result. This was not only important but necessary, since those injured and maimed might be looked at temporarily as heroes, but later would be certain to become objects of dread and loathing to their fellow men.

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WAR WOUNDS OF THE FACE

Description of war wounds. Eloesser (59) wrote that the war not only had developed much that was new, but had brought back much that was old. He stated that wounds were of a varied nature; those caused by knife, bayonet, and saber very rarely involved the face, while bullets, shells, and shrapnel frequently struck this part. Bullets might cause small wounds of entrance and exit, but great destruction in between. He believed, however, that every bullet was a dumdum bullet potentially; it might hit something on the way or something in the body. If it hit bone and shattered it, each fragment became a secondary missile which tore, crushed, and bruised the adjacent parts. If it hit sidewise, it produced a much larger external wound and caused extensive lacerations. The shell which broke into a multitude of small, jagged pieces inflicted wounds that were dangerous and became infected. Shrapnel was a combination of the shell and the bullet; the bullets were of lead, and were readily distorted and spattered around in the wound to lodge permanently in the body. Eloesser stated that burns and powder marks were frequently associated with wounds of the face, and while these might have serious sequelae, it was infection and hemorrhage that were the principal dangers of gunshot wounds.

The fractures which accompanied these injuries differed markedly from those seen in civilian life; they were characterized by comminution and loss of bone. The cavities of the face were frequently opened and filled with foreign bodies. The fragile

walls might have been shot away, and the contents of the orbit might have dropped. The mandible, being denser but more loosely articulated, was often completely shattered into numerous pieces. The entire bone or parts of it might have been shot away and left vast defects. All writers on war surgery pointed out the importance of saving all the bone that remained attached, even if held only by a thread of the periosteum, and of preserving the soft parts as well.

Hemorrhage. Bleeding from such wounds as described often presented grave problems. Kazanjian (111) stated that some hemorrhages were successfully treated by packing, clamping, or ligation. He described a clamp for the arrest of hemorrhage from the floor of the mouth, which was very effective for stopping bleeding from the lingual artery (Fig. 1).

Infection. According to Valadier (198), grave local and general sepsis, producing septicemia, meningitis, general pyemia, and mediastinitis occurred only occasionally. Among 1,010 cases of face and jaw injuries there were 27 deaths. Kazanjian (111) stated that one-fifth of the patients with jaw fractures developed bronchitis and bronchopneumonia.

Local infections were generally treated by continuous, multiple, deep irrigations, and especially by the Carrel-Dakin method (Sweet, 187; Dakin *et al.*, 43) for which excellent results were claimed. Fisher (65), at the suggestion of Dakin, used a 2 per cent aqueous solution of chloramine for wounds of the mouth and jaws. The solution was injected every hour through tubes inserted through the wounds to the infected area (Fig. 11). Others, however, preferred the use of antiseptic pastes. Morrison (150) developed a treatment which was a modification of the use of Beck paste. The paste was made of the following:

Bismuth subnitrate, 1 part	8 oz.
Iodoform, 2 parts	16 oz.
Paraffin, g.s. to make a soft paste	8 fl. oz.

The paste was placed into the wound and covered with a dressing.

As was pointed out by Sir Berkeley Moynihan (151), surgeons in World War I were well aware that, in addition to antiseptics, thorough mechanical exposure combined with perfect cleansing was "the supreme necessity in all cases." This included excision of all contaminated, infected, and dead parts, as well as removal of all foreign bodies. In addition, full emphasis was laid on the paramount importance of complete immobility of injured parts. This treatment was carried out with modifications, and specifically emphasized by Valadier, Kazanjian, Ivy, and others. Trotter (197) stressed early treatment with full, surgically secured access to the fracture, in order to limit hemorrhage, sepsis, and necrosis, and to obtain a limited and relatively aseptic scar.

Reduction and immobilization of fractures. It was recognized that fragments should be fixed in correct position as soon as possible; articles dealing with this subject are numerous. Pope (161) described an ingenious apparatus for stabilization of the mandible in case of loss of part of the ramus and angle of the jaw. Harrison (86), Dental Surgeon to the Anglo-Russian Hospital, published a very interesting article describing easily constructed wire splints to be used chiefly in first-aid treatment in field hospitals. These splints were designed by Tigerstedt of Kiev, and were easily made of German silver wire. Corrections of the fractured parts were made either by means of elastics, or by bending the wire with pliers.

Ivy (95), in a collective review published in 1918, stated that the metal band and wire splint were in general use for the fixation of the fragments of the mandible in their normal position in relation to the upper teeth in the majority of cases of gunshot fractures. These appliances consisted of stout wire spanning the gap where teeth or tissue had been lost, and they were attached by crowns or bands to sound teeth.

Splints and appliances of various types were described by almost all writers of this period. Some of them deal with this subject predominantly. Dolamore (51) made a plea for the early use of splints in cases of multiple or single simple fractures, as well as in fractures accompanied by destruction of bone and overlying soft tissue, to prevent facial deformity in anticipation of later plastic operations. Hopson (90) included the use of elastic traction on interdental splints, applied with long arms used as levers and extending out of the mouth. He also recommended stretching and sliding plates to force the jaw into occlusion if there was lateral deviation.

The care of patients at a Casualty Clearing Station was discussed by Mendelson (143). It consisted first of the primary treatment for shock, hemorrhage, and respiratory obstruction such as is often caused by edema of the tongue, lips, and floor of the mouth. Next came treatment to prevent secondary complications such as pneumonia and local sepsis. Then douches of saline solution were given at least every two hours, local antiseptics were applied, and the parts were put at rest with splints and chin supports. A thorough examination was made, including roentgenograms to locate the presence of foreign bodies, to deter-

mine the number and types of fractures, and to locate the presence of roots of teeth between the fractured parts. The cases were divided into those that could be splinted with ready-made appliances, and those that required a specially constructed apparatus. In the clearing station only a foundation could be laid for further treatment.

Reports from the *Dublin Base Hospital No. 83 at Boulogne* were published by Valadier, a Frenchman serving as a medical officer in the British Army. Valadier and Whale (198) reported on 1,010 cases of jaw and facial injuries. Illustrations of 12 cases of serious injuries demonstrated how gradual progress was achieved through the use of ingenious splints, the careful preservation of valuable tissue, and the patient's waiting for the right time to present himself for the successive steps of the surgical procedures. In general, these authors concluded that the primary closure of the wound is undertaken too late and all subsequent stages are undertaken too early.

The *Department of Oral and Plastic Surgery at Queen's Hospital, Sidcup, England*, had Gillies as surgeon-in-chief, whose work embraced some of the most remarkable facial restorations done during the war. He published the results of his early work with King in 1917 and 1920 (70, 71, 73). His monograph "Plastic Surgery of the Face" is a classic. In his hospital, which was placed on an "Imperial basis," Gillies had the co-operation of Waldron and Risdon (Canadian Section), Newland (Australian Section), and Pickeril (New Zealand), as well as Blair who arrived in 1918 with an American contingent among which was Ferris Smith. Blair (21) published his own experiences with face and jaw injuries in 1920. Fry (66) was the chief dental surgeon and wrote a chapter on the use of prostheses in relation to plastic surgery for Gillies' book.

At the *Southern General Hospital, Birmingham, England*, Parrott (157) wrote that practically all cases arrived in a state of sepsis, more or less acute, so that irrigations and dressings to prevent extension of the infective process had to be used. Trismus caused by wounds was general and presented a serious obstacle to the preparation and insertion of splints. Trismus was treated with mouth gags and spring clothes pegs, or by stretching under nitrous-oxide anesthesia, and if due to deep cicatrix, by surgical division of the strands of scar tissue.

At the *Croydon War Hospital, England*, 166 beds were entirely devoted to jaw cases when Colyer (37) wrote his first paper dealing with 204 cases that were under treatment during the first six months after the opening of the hospital. This paper is well

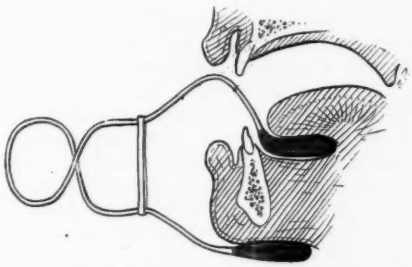


Fig. 1. Kazanjian clamp for hemorrhage from the floor of the mouth.

worth studying for its valuable case reports, and a second paper by Colyer (39) is probably one of the most elucidating documents on jaw surgery coming from Great Britain. In contrast to other writers, Colyer justified the "sacrifice of teeth" in the region of the fracture, "because," he stated, "they present a focus of infection which considerably increases the chances of nonunion. . . ." He pointed out that many cases of delayed union were due to neglect of the most elementary surgical principles, such as direct wiring in septic comminuted fractures and failure to remove the cause of sepsis. He gave cases to illustrate that in comminuted fractures the teeth near the fracture line had caused delay in union and that union occurred when they were removed. This, he stated, justified the practice at the Croydon Hospital of removing any source of infection at the earliest possible moment.

In the *Chaptal and Lariboisiere Hospitals in Paris*, Sebileau (175), whom Brophy called the untiring, highly skilled surgeon who worked by night and day, did some excellent work with Lemaire and Villain (199), who co-operated with him in devising many appliances for the immobilization of the bone fragments of the jaw. In a very fine article Sebileau (176) pointed out that there was a great difference between the treatment of jaw fractures and fractures of the long bones. He stated that the site of the fracture should not be opened externally, and that the removal of bone splinters was contraindicated. Jaw fractures generally were widely opened and well drained by their own disposition, and constantly flooded by saliva which exercised a beneficial chemotactile action.

In the *Second Northern General Hospital, Leeds, England*, injuries of the face and jaws were treated by Munby, Forty, and Shefford. A report of 200 cases was published by them (152) in which they cited the quotation, "The excellence of every art depends upon the complete accomplishment of its

purpose." Judging by the final disposal of their patients, their methods have been justified. Shefford (180) described the management of these cases. Sepsis was controlled by constant lavage and by the earliest possible treatment of the fractures. Following Colyer's recommendation, teeth were extracted when involved, except in cases in which tissue loss was considerable and bony union unlikely. It was recognized that the power of comminuted particles of bone to generate fresh bone tissue is remarkable, and that therefore these particles should be retained to help in the process of ossification and consolidation.

The Harvard Surgical Unit, which was formed in June, 1915, counted Kazanjian among its members. He was made chief of the dental section and was assigned to General Hospital No. 22, British Expeditionary Forces; later he was transferred to General Hospital No. 20. Kazanjian wrote many articles which were published in the English (110, 111, 114), the French (109, 113, 112), and American (111, 115) literature; one of his best early publications is found in the War Supplement of the British Dental Journal (110). He based his treatment on a classification of fractures, which is as follows:

1. Mandibular fractures
   a. Simple fractures anterior to the last existing tooth
   b. Multiple fractures anterior to the last existing tooth
   c. Fractures posterior to the last existing tooth
   d. Fractures with missing bony tissue of considerable size
2. Maxillary fractures
   a. Simple fractures of the alveolus
   b. Partial fractures of the maxilla
   c. Fractures with perforation
   d. Fractures of the entire maxilla
   e. Fractures with loss of bony tissue

Kazanjian obtained exceptionally fine results in comminuted fractures and gunshot wounds accompanied by extensive soft-tissue destruction. He performed some of the most remarkable plastic operations undertaken during the War, and effectively restored horribly mutilated faces. Kazanjian (115) emphasized the value of various types of prosthetic appliances, which he inserted immediately after the injury to support the tissues while they were still soft and flexible, and to prevent undesirable adhesions. Kazanjian's extraordinary success with badly comminuted fractures was based on the method of suturing osseous splinters. This procedure was described in *Ash's Monthly* (114) and the *Journal of the American Dental Association* (116). Sutures were made through the exposed fragments of bone in the mouth; these were then assembled by attaching them to a wire or bar fastened to the teeth, as shown in Figure 2, or to a bar extended from a head band. Even though approximation was not possible everywhere, if there was contact, the probability of junction was very good. The wire sutures were removed after from three to four weeks, and a chin cap was used to counteract the pull of the depressor muscle on the not yet too solid bone. Kazanjian stated that this method safeguarded the facial contour and enhanced the result of later plastic operations, some of which were described in the *International Journal of Orthodontics* (115).

In the *Dental Section of the American Ambulance at Neuilly (Paris), France*, Chief Dental Surgeon Hayes and his associate, Davenport, treated a large number of difficult and interesting cases which were faithfully reported in a series of articles in the *Dental Cosmos* (87). These are well worth studying for the description of ingenious methods used to reduce unusual fractures and treat disfiguring wounds. Le Cron (120) described some of the splints used for treatment, which, he stated, were especially important in bone-grafting operations in which the jaws should be held rigidly together.

The Dental Department of the United States Army Hospital No. 11, Cape May, New Jersey, published a resume of the treatment of ununited fractures of the jaws. In the article written by Chief Dental Surgeon McCauley and Worthley (134), it was pointed out that an interdental splint should always be used in fractures of the mandible with large loss of bony substance or extensive comminution, and especially if molars are present which can be used as points of fixation. These splints were made of cast aluminum and were locked by a pin and tube device, which allowed rapid opening of the jaw in an emergency (vomiting) or for the treatment of intraoral complications, but gave solid fixation which is essential in bone grafts.

BONE GRAFTING

Bone grafts were discussed in most of the important articles on the treatment of war injuries to the jaws. Among the most outstanding are papers published by the following surgeons: Morestin (149), Horsley (91), McWilliams (138), Du Bouchet (54), Cavalié (33), Imbert and Réal (92), Sebileau (175, 176), Gallie and Robertson (69), Fry (66), Cole (36), Ivy (94, 95, 96), Lyons (130), Shefford (180), Lindemann (124), Tainter (188), Waldron and Risdon (204), and Brown (25). A superb monograph was published by Gillies (70).

When to use bone grafts. All authors (*supra*) agreed that bone grafts should be used in cases in which bony union had failed to occur, in which a so-called pseudarthrosis existed, and in cases with great loss of substance. Ivy put down the following requirements: operation should be performed only (a) in the absence of local inflammatory or other pathological conditions; (b) if communication with the oral cavity can be avoided; and (c) if perfect immobilization is assured by fixing the lower teeth to the upper. Shefford stated in addition that the best results were obtained if both fragments contained teeth to produce absolute immobilization.

Types of bone grafts. The following operations have been recommended:

1. Osteoperiosteal graft
2. Sliding graft or pedicle graft
3. Thick free autogenous graft

The osteoperiosteal graft may be used in connection with freshening of the fragments when the bone is in good position but has failed to unite. The graft is a thin layer of bone with periosteum, taken from the anterior internal surface of the tibia. According to Fry, dental splints must be worn to hold the fragments immobilized from two to two and one-half months. If not enough teeth are present, direct bone wiring is required. This method was also strongly advocated by Delaniere (46).

The sliding graft was championed by Cole, Chief of the Maxillofacial Department of King George's Hospital, and by Tainter who worked with him and later used it in his own service at General Hospital No. 40. Together they performed more than 50 operations in which success was practically assured. Tainter used a modified detachable Gunning splint to secure immobilization of the jaw. He found the open-mouth position of value in such operations, for it facilitated feeding and eliminated muscular trismus. He stated that liberties can be taken with a pedicled graft which would not be tolerated with a free graft. Interosseous wiring was used to unite the fragments except in edentulous jaws, in which circumferential wires were applied.

The free autogenous graft consisted of a piece of bone with periosteum. It might be taken from the tibia, the ribs, or the ilium. Lyons (130) described the method of Gallie and Robertson, who inserted a piece of a rib 3 in. long—generally the seventh rib—into a saw-cut along the inferior border of the mandible about ½ in. deep and extending from 1 to 1½ in. back from the end of the fragments. The piece of rib was split and inserted with the smooth side toward the mouth; the cancellous surface was faced outward and was sunk somewhat below the surface of the jaw. The depressed bridged area was filled out with bone from the remaining part of the rib, which was placed into the gap with the smooth side facing out. Drill holes were made on each side for the use of kangaroo tendon unless the jaw could be well stabilized; in this case the graft was self-retaining and was wedged into the cuts which were made in the jaw by tapping.

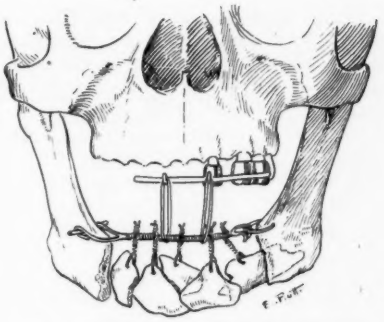


Fig. 2. Kazanjian's splint for comminuted mandibular fracture (Kazanjian, *J. Am. M. Ass.*, 1919, 73: 1268).

Gillies preferred the straight block graft. If the loss included the whole of the ramus, a piece of the seventh or eighth rib including the costochondral junction was used. The bony portion was wired to the freshened anterior fragment. The costal end projected into the glenoid fossa and formed a false joint. For less extensive loss of bone, Gillies believed that the main source of bone should be the ilium. Grafts from the crest of the ilium were used at Queen's Hospital at Sidcup, England (Risdon, 163), and were also recommended by Brown who secured the graft with kangaroo tendons. The graft from the crest of the ilium, he stated, is particularly useful if a curved graft is required. Waldron and Risdon also preferred to form their graft from the iliac crest. They attached the graft to the jaw by means of wires, fixing it firmly into position.

Billington (19) reported on the bone grafts done in association with Parrott in the Jaw Center at the First Southern General Hospital. He adopted a graft overlapping the freshened surfaces of the bone fragments, a so-called onlay graft. He remarked that tibial grafts are brittle, and while he first used a split rib, later he favored the anterior superior spine of the ilium, with the crest as far back as necessary. The detached piece of bone was often beveled and placed on its bed in such a way that the ends overlapped the gap by an

inch, resting on prepared raw surfaces in the fragments. The advantages of the overlapping were the broad lines of bony contact, which eliminated the risk of separation if the size of the gap was increased by the introduction of the dental splint, or other circumstances causing a displacement of the fragments of the jaw. Parrott (158) stated that the simple laying-in of the graft, which is left free until healed over, proved 100 per cent successful in obtaining osseous union in Billington's hands.

Methods of fixation of the mandible. Since a great deal depended on complete immobilization, which of course is most difficult in fractures at the angle of the jaw, the cast pin and tube splint (Waldron and Risdon, 204) gave the best results. For the edentulous patient, a Gunning splint with circumferential wiring has been universally recommended. The splint should be prepared and attached before the operation and locked as soon after as is safe, if general anesthesia is used.

Methods of attaching the graft. The best method for fixation of the graft, Imbert stated, was that of pointing the ends of the graft and thrusting them into the fractured extremities, which dispensed with all artificial and metallic means of fixation. The Germans, especially Lindemann of the Duesseldorf Clinic, took recourse to a great deal of grafting. According to Dolamore (51), they also cut the ends of the graft cone-shaped or wedge-shaped, and slid them into notches cut in the stump. They implanted pieces from 5 to 8 cm long, and insisted that the essentials of success were absolute fixity, a small operating wound (only ends of the bone stumps exposed), and the imbedding of the graft in the surrounding soft tissue before the skin wound was closed. On the other hand, Waldron and Risdon, after experimenting with pegs, steps, and dovetailing to obtain autofixation, came to the conclusion that the simpler methods were better. They did not like the peg and hole fixation because it was difficult to perform, and often destroyed the endosteal tissue which was of great osteogenic importance. They attached the graft by means of wire. Obviously Gallie and Robertson's method of grafting was the most satisfactory from the point of view of fixation of the graft because, as was stated, no means of wiring was needed in most cases, and still the contact made was good.

The Treatment of Fractures Between World Wars I and II

In this period new developments in locomotion contributed a great deal to the ever-increasing number of accidents involving passengers in vehicles driven by internal combustion engines, as well as to pedestrians and bystanders alike. The automobile and the airplane both contributed their share of fractured jaws. Kazanjian published a special paper (116) devoted to "The Treatment of Automobile Injuries" and their complications.

All classes of the population were equally exposed so that these injuries, which before occurred only to drunkards who became involved in brawls and were driven in the police ambulance to the emergency ward of a hospital, became more and more numerous among private patients. The treatment of fractures, therefore, became an important part of the practice of an oral surgeon.

Analysis of a Series of Fractures of the Mandible

Several articles containing an analysis of a series of fracture cases appeared in the dental literature in this period. These related in most instances to the mandible. The series will be referred to by numerals in the tables to follow. One report published in 1915 will be included for the sake of completeness. They are as follows:

	Author	Year	No. of cases
1.	Dunning (56)	1915	1,065
2.	Ivy and Curtis (102)	1926	100
3.	Reiter (162)	1928	50
4.	Schmutziger (172)	1929	179
5.	Dean (45)	1930	50
6.	Woodard (213)	1931	50
7.	Winter (210)	1934	200
8.	Weisengreen and Levin (208)	1936	60
9.	Asbell (7)	1939	115
10.	Haynen (88)	1939	669
11.	Doherty (50)	1940	100

The sex incidence was of some interest. As would be expected, there was a gradual increase in the percentage of females, which could be ascribed to the general use of the automobile and the participation of women in sports.

TABLE I.—ANALYSIS OF SEX INCIDENCE OF FRACTURES IN PERCENTAGES

Analysis	Year	Male	Female
1	1915	93	7
2	1926	90	10
3	1928	92	8
4*	1929	96	4
5**	1930	100	....
6	1931	82	18
7	1934	92	7.5
8	1936	71	29
9	1939	70	30
10	1939	...	....
11	1940	88	12

*In Switzerland. **U. S. Marine Hospital.

Statistics regarding the cause of the fractures were of interest, especially if they were compared

TABLE II.—ANALYSIS OF CAUSE OF FRACTURES IN PERCENTAGES
(Computed from data contained in the various articles)

Analysis	Year	Fists, blows	Falls	Assault	Auto	Bicycle	Hit by object	Sports	Extraction	Miscellaneous
1	1915	46.5	13.0		0.2			2.1	0.5	37.7
2	1926	49.0	14.0		8.0			3.0	5.0	21.0
3	1928	54.0	3.0	37.0	10.0		2.0			
4*	1929	0.7	6.2	20.0	4.4	17.0	25.9	5.1		20.7
5**	1930	38.0	10.0	28.0			9.0			34.0
6	1931	58.0	18.0		18.0		4.0			
7	1934	62.5	11.5		3.0		7.5			
8	1936	35.0	3.3		60.0					
9	1939	25.4	17.4		30.7		13.9			
10	1939	90.0	4.0		1.0			0.5		4.5
11	1940	47.0	17.0		8.0			10.0	1.0	17.0

*In Switzerland (Swiss Accident Insurance Company, "Suval").
**U. S. Marine Hospital.

with the period of time in which the reported accidents occurred. The places where the injuries occurred, however, and even the locations of the hospitals where the patients were treated might be of considerable influence on the data collected for comparison.

The type of injury was classified differently in the various reports. Table III gives an analysis of those authors who reported whether the fracture was single, double, or multiple. In many cases of double or triple fracture the condyle was involved. Asbell reported 3 such cases, Dean 9, Ivy and Curtis 24, Woodard 12, and Haynen 28.

The degree of injury and the presence of complications are of great importance in the treatment of fractures. Among Asbell's 115 cases there were 25 compound and 14 comminuted fractures. Dean reported among his 50 cases, 1 with cellulitis, 3 with osteomyelitis, 33 with teeth in the fracture line that were removed on admission or before, and 8 with syphilis; in 4 cases the fracture extended through impacted unerupted teeth, but retention did not influence the healing disadvantageously.

The location of the fracture is of importance in the treatment. It has been thoroughly tabulated by many and (Table IV) combines the data contained in the various articles.

It is evident that fractures of the coronoid process are very rare. Condylar fractures may easily be overlooked, especially in multiple fractures and when they are asymptomatic or not demonstrated in the x-ray picture. Special x-rays should be taken routinely to show the condyles in anterior and lateral views.

IMPROVED METHODS OF TREATMENT OF MANDIBULAR FRACTURES

Some methods used before the World War were improved upon; others were simplified so that adequate fixation could be obtained by means of appliances which required a minimum of technical work and gave maximum results with less discomfort to the patient.

The following were essential requirements for the selection of a method for the treatment of jaw fractures as set forth by Winter in 1934:

1. Good immobilization of the fragments
2. Perfect occlusion of the teeth
3. Simplicity of application
4. Cleanliness
5. Comfort to the patient (See Table V)

TABLE III.—ANALYSIS OF TYPE OF FRACTURES IN PERCENTAGES

Analysis	Year	Single	Double	Triple	Multiple
1	1915	89	10	0.5	0.1
2	1926	68	31	1	
3	1928	64	34		
4	1929				
5	1930	62	32	6	
6	1931	56	42	2	
7	1934	63	34.5	2.5	
8	1936	70.0	25	5	
9	1939	66.1	16.5	4.3	2.6
10	1939	71.3	28.7		
11	1940	66	31	2	1

TABLE IV.—ANALYSIS OF SITE OF FRACTURES IN PERCENTAGES
(Computed from data contained in the various articles)

Analysis	Year	Symphysis	Incisor region	Canine region	Premolar region	Molar region	Angle	Ramus	Condyle	Coronoid
1	1915	6.5	16.5	17	21.25	53.75		5.0	0.8	0.2
2	1926	8.8			30.8	8.8	44.1		7.3	
3	1928									
4	1929	13.3	8.1	11.9	12.5	22.2	11.9	11.9	18.5	
5	1930	16.1			12.9	9.7	58.1		3.2	
6	1931	7.5		10.6	22.7	21.1	33.3	3.0	0.15	
7	1934	10.3	5.6	14.3	13.4	33.4	18.2	0.8	3.2	
8	1936	5.0								
9	1939	5.2		9.0	20.15	22.38	20.9	3.2	9.0	
10	1939	7.2			31.6	8.4	43.6	0.2	6.5	2.1
11	1940	15.1			30.3		48.4		3.0	3.0

CLASSIFICATION OF MANDIBULAR FRACTURES

A modification of Kazanjian's classification was published by Kazanjian and Thoma in 1938. It relates to treatment and is as follows:

1. Fractures with sound teeth on either side of the fracture line
2. Fractures with sound teeth on only one side of the fracture line
3. Fractures of edentulous jaws, or jaws with no serviceable teeth present in either the upper or lower jaw, or both.

THE TREATMENT OF MANDIBULAR FRACTURES

Intermaxillary ligation. This method seems to have been given the preference in the series of fractures reported in Table V. It was first introduced by Gilmer in 1887. Several variations have been suggested. The best known was the so-called "eyelet method" developed by Eby (57) and Ivy (98). This was an improvement of the Oliver method described before, which was adapted by Silverman for vertical wiring, but instead of depending on a wire placed around two teeth and passed through the loop to be attached to the opposite jaw, as shown in Fig. 3, the loops were attached to the upper and lower teeth separately and secondary wires were used for intermaxillary ligation (Fig. 4). Angle's brass ligature wire, gauge 0.02, was used. This method had the advantage that if it was necessary to open the mouth, it could be accomplished by cutting only the secondary wires which were easy to replace, while the wire on the teeth remained intact. A further improvement prevented the eyelet from slipping back deep

TABLE V.—ANALYSIS OF TREATMENT METHODS IN PERCENTAGES

Analysis	Year	Intermaxillary ligation	Eyelet method	Arch wires	Elastic traction	Winter, Jelenko arches	Splints			Barton bandage	Circumferential wiring	Direct wiring
							Single	Interdental	Kingsley			
1	1915											
2	1926		79.0	10.0				6.0		2.0	1.0	
3	1928											
4	1929											
5	1930		90.0			6.0		4.0				
6	1931	42*	38									
7	1934	72.0	1.5			17.0	9.5					
8	1936		90.0	10.0								
9	1939	35.6						1.0		10.4		3.4
10	1939	52.7			30.3					3.3	13.7	
11	1940				52.0							

*Gilmer arches.

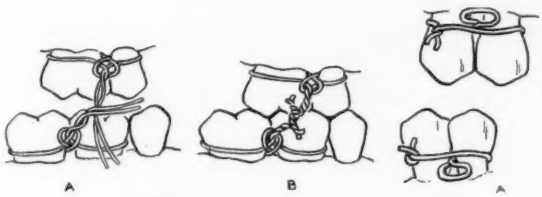


Fig. 3.

Fig. 3. Eyelet wiring (Silverman's method).
Fig. 4. Eyelet wiring (Oliver, Eby, Ivy method).

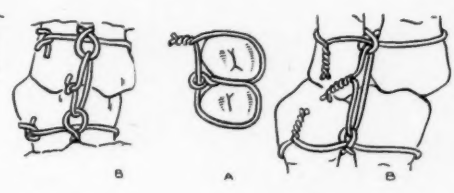


Fig. 4. Fig. 5.

Fig. 5. Eyelet wiring (wire passed through loop).

into the interdental space while the wire around the teeth was tightened; it consisted of passing one of the original wires through the loop (Fig. 5).

Risdon described a twisted type of arch wiring in 1936 (165). The wire was placed around the right second molar and twisted on itself until a twisted cable extended as far as the central incisor. The same procedure was repeated on the left side, after which the two cables were twisted together in the median line. Thus a fairly firm arch was made for either the upper or lower jaw. Individual teeth were then wired to this arch, and interdental splinting could be accomplished by connecting the two cables with secondary wires.

Dental splints. New types of splints have been devised with the point in view of overcoming some of the inherent disadvantages of a dental splint. Splints attached to the teeth were efficient because of the greater strength and security which they gave to the fractured jaw. If sufficient teeth were present, patients might even be allowed to eat soft food if the fracture was a simple one. Such splints made of vulcanite or cast silver, in one or two pieces with a hinge and locking device, were still favored by Risk in 1941. Willet (209) described a cast splint made up of a row of overlays which did not irritate the gingival margin and interdental tissues. Morgan (149) described an improved splint for fractures of the upper jaw. It was made of a Gilmer arch bar, to which were soldered the Marshall tubes for insertion of the Kingsley wings.

Splints were also useful in fractures of edentulous jaws. The Gunning splint has remained in use, and it was recommended that splints be improvised by wiring together the two dentures, if the patient wore them; they could then be placed in the mouth and the jaws held in position with a bandage. Bandages with elastic traction were recommended by Gingrass (75), Dingman (47), and Miller (144). The latter used a skull cap or surgeon's cap with a rubber dam fastened to the cap with safety pins. Kazanjian (116) recommended a Barton bandage reinforced by elastics attached at each side of the face with adhesive strips. Mead (141) advised the use of the plaster head cap of Scogin (173) with a rubber dam strapped on around the chin.

Circumferential wiring. A great improvement in the use of splints for fractures of edentulous mandibles resulted from the introduction of circumferential wiring, as first advocated by G. V. Black and described by Ivy (98, 99), Goodsell (76), Bender (12), Addison (3), Jones (108), Parker (153), Thoma (193), and Doherty (49). The instrument used to introduce the wire varies; some like the cannula of a trocar, others use an eyeleted trocar, a ligature carrier, or a curved hypodermic needle (Fig. 21). For wire, 16-gauge silver wire was first used, but 22-gauge stainless steel has today replaced the former. It is fastened over the patient's artificial denture, or a vulcanite or metal splint which is made to fit the alveolar ridge.

Elastic traction. The gradual reduction of fractures by intraoral and intramaxillary traction was first described by Darnall (44) in 1923. It was used in cases in which immediate reduction was not possible either because of fragments held in a displaced position by muscle spasm, or because the fracture had consolidated to a greater or lesser extent as the result of delayed treatment. The appliance used for intermaxillary traction was a modified Gilmer arch applied to both the upper and lower teeth. Lugs soldered to the bar pointed up or down, respectively, and served to attach small elastic bands. Darnall pointed out that an additional advantage of using elastics in the Navy lay in the fact that they were easily removed, or if reduced in number, the patient could force his jaws apart by grasping the chin and pulling it down in case of sea sickness. This also applied to all wounded men transported by ship or plane. Moorehead (147) stated that he used elastic traction in practically all cases in which reduction was required, and that the mechanism employed served equally well for immobilization. Winter (210) introduced a prepared splint which could be easily shaped to conform to the outline of the dental

Fig. 6. Kazanjian buttons (Thoma, *Traumatic Surgery of the Jaws*, p. 108).

arch, to which it was attached by fine wires passed around most of the teeth. Round lugs served for the attachment of elastic bands. Kazanjian described a simplified method of affixing rubber bands. He formed buttons from wires passed around two adjoining teeth; these wires were twisted until they were wound into a knot (Fig. 6). The method was described in Kazanjian and Thoma's chapter on "Fractures of the Facial Bones" in Scudder's "The Treatment of Fractures," eleventh edition, page 370.

The posterior edentulous fragment. Waldron (201, 202) wrote that attempts were made to hold down the posterior fragment by means of a screw passed beneath the zygomatic arch into the coronoid process, or by the insertion of a nail beneath the zygomatic arch and above the mandibular notch. Following this, other methods were devised to counteract the muscle pull which caused this displacement, and to reduce and stabilize the fragment of the mandible. Lenormant and Darcissac (121, 122) described a method of drilling a hole into the posterior fragment on both sides at the angle of the jaw, and passing a wire through the skin. The ends of the wire were connected by rubber elastics across the back of the neck. Ivy and Curtis (104) suggested the attachment of the wire by means of elastics to a hook in a plaster cap. The procedure of Ivy was recommended by Doherty (50) and Dingman (47). Dorrance stretched a wire from an intermaxillary metal splint, from which a bar extended out of the mouth to the angle of the jaw, hugging closely the surface of the face. Here the wire was attached to a vitallium pin inserted into the angle of the jaw through the skin. Gross (79) described a similar appliance. MacGregor (132) used an apparatus attached to a plaster cap from which an arm descended, holding a swivel rod. The appliance allowed more accurate adjustment than those described heretofore. Thoma (189) described a screw extension from a maxillary splint that could be regulated, while Kazanjian (116) preferred a splint attached to three posterior mandibular teeth, which had a 16-gauge wire extending to the ramus with one or two prongs which prevented upward displacement of the posterior fragment. Waldron mentioned the use of a grooved splint extension, and Aufderheide (8) described a lug.

Open reduction. Direct wiring has generally been condemned by writers of this period. Ivy (98) stated that direct osseous wiring and the use of bone plates caused osteomyelitis and sequestrum formation, because most fractures were compounded into the mouth; furthermore, he added that they gave insufficient stability. Berger (13) agreed that both fixation by means of silver or bronze wires applied through drill holes, as well as the use of metallic plates (Lane plates) attached to the bone across the fractures have not only invariably failed to secure union, but have caused necrosis and loss of considerable bone. Waldron (201, 202) wrote that direct surgical wiring has been so frequently followed by postoperative infection, necrosis, sequestration, and nonunion that this method has been largely abandoned. Kazanjian (116), in contrast to the others, reported success with intraoral osseous sutures, which, he stated, were much simpler to apply than sutures requiring an external incision. He let the wires protrude through the mucous membrane for drainage.

FRACTURES OF THE CONDYLE

Since the beginning of World War I and the development of x-ray examination, condylar fractures were diagnosed not only more accurately, but also more frequently, because this fracture when occurring with other injuries was formerly often overlooked. Rüedi (169) and Dufourmental (55) made the first comprehensive studies of condylar fractures.

Complications. Thoma (192) classified complications as follows:

1. Overriding of fragments
2. Forward, medial, lateral, and backward displacement of the condylar fragment
3. Forward, medial, and lateral dislocation of the condyle

Of these complications, overriding of the fragments is seen in almost all fractures through the neck of the condyle, since most of the fractures are of the extracapsular type, occurring in the subcondylar area. Forward displacement is common because of the attachment of the external pterygoid to the condylar fragment. Medial, lateral, and backward displacements are due to displacement by the overriding mandibular fragment (Fig. 7). Dislocation is fairly common because of the free movement of the condyle within the capsule, so that the force of the trauma may push it out of the glenoid cavity (Fig. 8). Bellinger, Henny, and Peterson (11), in an analysis of 100

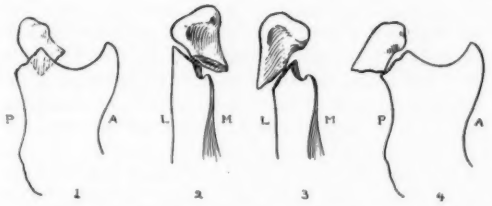


Fig. 7. 1, Forward; 2, medial; 3, lateral; and 4, backward displacement of neck of the condyle. P, posterior; A, anterior; L, lateral; M, medial.

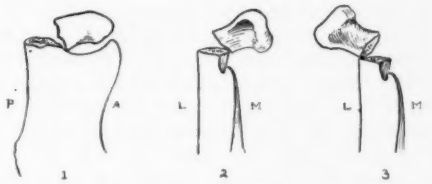


Fig. 8. 1, Forward; 2, medial; and 3, lateral dislocation of the condyle. P, posterior; A, anterior; M, medial; L, lateral (Thoma, *Traumatic Surgery of the Jaws*, p. 276).

cases, found overriding with no displacement in 16 per cent, displacement in 57 per cent, a dislocated condyle in 25 per cent, and fracture involving the joint surface (intracapsular) in 2 per cent of the cases. These complications are disclosed by means of roentgen films taken from different angles; a lateral view and an anteroposterior exposure will generally be sufficient for a correct diagnosis. The lateral view should be without interference of the spinal column, with a clear view of the ramus and condyle.

Walker (206) described gunshot injuries of the condyle. These might be so extensive that it would be difficult to classify them except as separate entities. If the injured person survived, ankylosis developed either because of the injury itself, or because of secondary infection which set in.

Examination. Walker (206) stated that symptoms were absent in some cases, while in others swelling and discoloration appeared over the area; pain and tenderness were increased by movement; there was inability to masticate because of open bite; and incorrect occlusion, crepitus, and abnormal mobility were found. Examination would reveal swelling, inability to incise, trismus (marked or absent), and injury on the chin or side of the face. In unilateral fractures the chin deviated to the injured side when the mouth was opened; in bilateral fractures forward excursion of the jaw was impossible. Often there was hemorrhage from the ear, which indicated injury to the auditory canal. Palpation with the fingers in the auditory canal might disclose the abnormality. Round (167) used the stethescope to detect crepitus.

Treatment. In treating condylar fractures, the main effort of most of those who wrote on this subject in the past has been directed toward the attainment of normal occlusion of the teeth. Very little has been done to correct displacement and dislocation of the condyle. The following methods have been advocated:

Immobilization by intermaxillary ligation, i.e., conservative treatment, has been advocated by Cole and Bubb (35), Boon (24), Aufderheide (8), Ivy and Curtis (102), James (106), Mead (141), Winter (211), and Berger (14). Bonney (23) used intermaxillary wiring in a case associated with open bite, tightening the wires every day until normal occlusion was obtained. The time of healing was believed by most writers to be five weeks. Cole and Bubb (35) used splints to keep the mouth in open bite position, and Russell (171) also recommended this treatment. Walker, however, pointed out the correct fact, that this tended to result in union in malocclusion. Waldron (201, 202) believed that intermaxillary ligation gave satisfactory results even when the condylar fracture was associated with dislocation. Steinhardt (185), who also recommended conservative treatment for dislocated fractures, believed that as a result of function the dislocated condyle would be rebuilt and form a new, well functioning joint. Fry (68) and others believed in fixation for from two to three weeks only, to be followed by active movement. Dufourmental (55) recommended the use of arch wires and elastic traction to control the movement. Walker, on the other hand, stated that active movement or movement controlled by elastics led to the formation of a false joint. Thoma (194) agreed with him, and presented a patient eighteen years old, who had fractured his jaw at the age of nine years. Inadequate treatment led to pseudarthrosis with pain and limited motion (Fig. 9).

The treatment of fractures of the condyle in children with successful results by the conservative wiring method has been reported by Brown and Hamm (26) and Thoma (191). Krohn (119) recommended the use of intraoral splints with extraoral extension for the application of rubber-band traction from a plaster-of-Paris cap applied to the head in order to correct open bite.

Functional treatment to allow active movement of the jaw was advocated by Zemsky (214), Guy (83), and Steadman (184), all of whom felt that immobilization was unnecessary, inadvisable, and

often resulted in incomplete function. Walker rightly pointed out that inadequate fixation or early movement frequently resulted in nonunion.

Opinions obtained on the results of methods described. While the opinion has been almost universally expressed that condylar fractures take care of themselves if intermaxillary ligation is applied, careful checking of the ultimate results did not give so good a picture. Campbell (31) reported restricted motion of the mandible following such fractures. Risdon (164) reported ankylosis in 5 per cent of the treated cases; Federspiel (62) stated that he never had a case of dislocated and fractured condyle in which limitation of motion was avoided. Gruber and Lyford (81) checked on 10 patients treated between 1925 and 1941 by intermaxillary fixation for six weeks, and found that 5 had minimal loss of function; 3 had appreciable loss of function, malocclusion, and deviation of the mandible; and 2 suffered ankylosis requiring arthroplastic procedures.

The realization through careful checking that the results of treatment with intermaxillary ligation were not so good as reports of individual cases led one to believe, had stimulated attempts to improve the technique both of reduction as well as of fixation of fractures of the condyle. Since there was no doubt that more than average skill and experience was needed to practice open reductions, almost everyone has been trying to develop a conservative method that would give satisfactory results in the hands of the average practitioner.

Reduction through leverage and traction. In order to correct shortening of the ramus caused by overriding, Ivy and Curtis (104) suggested interposing a base plate gutta percha between the molar teeth before fastening the teeth in occlusion. Waldron (201, 202) placed a split piece of rubber tubing between the upper and lower molars; while Gruber and Lyford (81) inserted increasingly larger wooden wedges between the posterior teeth to overcome the muscle spasm which caused the overriding. Thoma (190) stated that he has used elastic traction with bite blocks for some time; Jelenko splints were attached to the upper and lower jaws and traction was applied in the anterior part of the mouth in order to get as long a lever action as possible (Fig. 23). This method has universally resulted in good occlusion, but has not corrected the overriding at the neck of the condyle. Experimental use of thicker bite blocks or stronger external traction from the chin to a head cap did not bring better results. The failure was due to the accessory mandibular ligaments which limited the distance the mandible could be pulled down against the elevator muscles of the jaw.

Operative procedures. The operative reduction of condylar fractures with marked displacement was strongly advocated by Silverman (182). His method consisted in an intraoral incision along the anterior border of the ramus, and after the tissue from the inner surface of the coronoid process was lifted, the condyle was pressed outward and back by means of a urethral sound while the condylar area was felt for from the outside. When contact was established, the wires, which had been previously attached to the teeth, were twisted together to effect intermaxillary fixation.

Thoma (191) has reported success in pulling back a medially displaced condyle with a sharp hook through an incision made in front of the ear, as used for arthroplasties, while the ramus was pulled down by an assistant. Aison (4) advocated direct osseous wiring, and Wassmund (207) and Steinhardt (185) recommended that this procedure should be used for displaced condyles if there was no hope for union. The latter reported a case of double condylar fracture with dislocation in which a good anatomical as well as a good functional result was obtained by direct wiring. Dingman (47) condemned all methods of open reduction, having seen several cases of ankylosis follow "meddlesome surgical measures."

Strömberg (186) was the main representative of the most radical school. He recommended condylectomy, because of experience with other joints in which luxated fragments produced arthritis deformans unless reset or extirpated. Bellinger (10) reported sequestration of the condyle in a case of head injury with swelling and abscess formation in the right cheek. Berger (14) also favored complete removal of the condylar fragments if they cannot be brought into a satisfactory position by manipulation. Walker (205, 206), on the other hand, took the position that patients with a condylectomy might have occlusal disturbances which were likely to be a greater disadvantage than the changes occurring as a result of fracture dislocation. He recommended condylectomy only for cases in which severe pain or ankylosis resulted.

Stabilization of the mandible. All methods described, except condylectomy, required that the mandible be immobilized until the condylar fracture has healed. Stabilization may be accomplished by intermaxillary wiring, or by traction in cases with open bite.

Difficulties occurred when the mandible or maxilla were edentulous. The immobilization in such cases might be accomplished by splints, although these are not always effective. Waldron (202) described a case in which a Kirschner wire was drilled through the symphysis, by which, after

forcible reduction, the mandible was held in position by means of forward and upward rubber-band traction applied from an unusual head appliance and U-shaped wire. Thoma (194) used internal wiring from the nasal aperture over a maxillary denture to an arch supplied to the lower teeth (Fig. 10).

No doubt there is an opportunity for developing still better methods of reduction and fixation of condylar fractures, which seem to have become more common during the last decade or two.

FRACTURES OF THE MANDIBULAR RAMUS

Fractures of the mandibular ramus are comparatively uncommon. Very little has been written about them. The best paper on this type of injury is that of Walker (206). The fracture generally descends from the mandibular notch. We may distinguish: (1) oblique fractures extending in a posterior and downward direction, the most common; (2) fractures in a forward direction which are the so-called fractures of the coronoid process; (3) vertical fractures; and (4) horizontal fractures. Vertical and horizontal fractures are rare. Fractures of the ramus have been reported by Colyer (38, 39), Blair (20), Mead (140), Crawford and Watt (42), Walker (206), and Thoma (190). Comminuted fractures are generally caused by shrapnel, bullets, and bomb splinters which produce penetrating or glancing wounds; these were particularly well described by Walker.

Treatment. Walker stated that in the treatment of posterior oblique fractures the mandible should be fixed for about five weeks in a closed position. He treated anterior oblique or coronoid fractures the same way to prevent fibrous union or nonunion, because he found that displacement caused by trismus of the injured temporal muscle disappears rapidly with immobilization. He stated that transverse and vertical fractures unite with no resulting deformity even if displacement was severe, which contraindicates wiring by open operation as recommended by Coughlin (41). The prognosis of gunshot fractures, in Walker's opinion, was very good. Dental co[illegible]cations were absent, and generally the fractures were not compounded into the mouth. He stated that débridement should be done with great care, and bone that might be a decisive element in the union of the fragments must not be removed. Drainage should be established if there is any infection.

The Treatment of Fractures During World War II

Ivy (101) wrote: "While the principles of treatment of fractures of the jaws were well understood thirty years ago, and fixation by apparatus applied to the teeth resulted in successful restoration of occlusion, there have gradually been developed simplified methods of fixation which require less technical work and which assure more rapid results with greater comfort to the patient." Ivy referred to skeletal fixation as "a valuable adjunct when the time honored methods are not applicable."

Skeletal fixation which requires the use of an external appliance, and internal wiring fixation with the wires concealed were developed in the period under discussion. Another innovation was the discovery of the sulfonamides, chemotherapy being applied both to prevent and to control infections associated with compound fractures and war wounds of various types.

WAR WOUNDS

Soon after the outbreak of the war, Fry (68) published an article in which he stressed the importance of preparation of the profession to give first aid to jaw injuries caused by air raids, and urged that patients with such injuries be passed on to special hospitals as soon as possible.

Parrott (158) stated that the first-aid treatment should consist of the following measures: diagnosis of fracture; control of hemorrhage and danger of suffocation; cleansing and irrigation of facial wounds; removal of foreign bodies, roots, and bone fragments; reduction of fractures and temporary fixation by wiring, splints, bandages, and adhesive tape; and suture of wounds and flaps in an emergency.

World War II brought with it injuries both to the civilian population and to the men serving in the armed forces. A report dealing with 119 cases of jaw fractures treated in an E. M. S. (Emergency Medical Service) Maxillofacial Unit between September 3, 1939 and December 31, 1940 was contained in an article by McIndoe (136). Half of these cases had other injuries and most of them were due to extreme violence. Bomb and mine explosions and penetrating missiles accounted for 45 per cent; collisions of high-speed vehicles such as motor cars and airplanes for 36 per cent, and collapse of buildings for 13 per cent. Interdental wiring and cast-metal cap splints with pin lock were used for fixation; suturing twenty-four hours after the accident was found inadvisable; the wounds, instead, were packed open with vaseline gauze and adequate drainage was established. To control sepsis, McIndoe recommended the removal of the teeth from the fracture line and irrigation by Shepard's saline drip (181). This consisted of a bottle containing hypertonic saline

solution (1.5 per cent NaCl) which was connected with a drain tube inserted into the wound by means of a rubber tube holding a visible drip regulated to 120 drops per minute. The irrigation was controlled by the patient and used for one-half hour every three to four hours (Fig. 11). Loss of bone occurred in 12 per cent of the cases, and was treated with bone grafts if the space was more than one centimeter long. These were inserted from four to six months after the signs of sepsis disappeared, during which time the fragments were splinted. Bone from the iliac crest was used; after shaping, this was wired correctly between the exposed fragments with stainless steel ligatures.

MacGregor (133) pointed out that sepsis in the jaws, as elsewhere, depended not only on the infecting organism, but also on the resistance of the patient. He stated that in an analysis of 100 cases treated at the Hill End Hospital and R.A.F. Hospital in Halton, England, it was found that in the age group of from twenty to twenty-nine years the incidence of sepsis was 30 per cent. It rose until in the age group of from fifty to fifty-nine years it reached 70 per cent. The infection might be due to the presence of foci of infection, or might be introduced by a foreign body, through a tooth socket, or along lymphatic channels at the time of the fracture, or later. The analysis also disclosed the fact that while the average time for union in nonseptic cases was four weeks, in septic cases it increased to seven and a half weeks. The question of external drainage was discussed by Rushton (170). He stated that at the Plastic and Jaw Injury Center E.M.S., Basingstoke, England, many cases were seen in which drainage was urgently required and had not been provided. He summed up his article by enumerating instances of compound mandibular fractures in which external drainage was advocated:

1. In all cases in which there is an external communicating wound
2. In all cases in which the fracture hematoma has been destroyed and infected, even though no pus can be seen nor is suspected
3. In cases with a very large hematoma beneath the fracture
4. In all cases with a collection of pus, or a sequestrum at the lower part of the fracture line
5. In certain late cases in which there is progressive bone loss

Chemotherapy. As early as 1939 the British Royal Army Medical Corps recognized the value of the prophylactic use of chemotherapy. In this country, Ivy (100), a member of the Committee on Surgery of the National Research Council and of the subcommittee on Plastic and Maxillofacial Surgery, enumerated the objectives and principles of management of injuries of the face and jaws, and pointed out that one of the first considerations in the treatment of wounded soldiers was the combating of infection. Wounds should be carefully revised, foreign bodies removed, abscesses opened, and drainage established. Local and general chemotherapy should be employed when indicated by cultures.

Mitchell, Logie, and Handley (146), in describing their experiences in treating war casualties in a base hospital in Libya, recommended the local use of sulfanilamide together with 1.5 gm. by mouth given three times a day for six days, as a prophylactic measure, and larger doses in cases in which the wounds were already infected. Campbell and Smith (32), who referred to compound fractures of various bones in civilian practice, stated that chemotherapy has reduced the incidence of infection by 10 per cent, and that in conjunction with sulfonamide drugs, internal fixation was well tolerated.

Haddock (84) of the Dental Corps, U.S.A., in a small series of cases (18) of mandibular fractures, found a marked reduction in the percentage of infection in the cases receiving sulfathiazole therapy as compared with the percentage in a control group of 15 cases receiving no chemotherapy. The treatment consisted in the oral administration of sulfathiazole (4 gm. on admission and 1 gm. four times a day), as well as daily implantation if there was sufficient access to the fracture.

Amies (5) stated that in the Middle East and the desert, where the problem of the hemolytic streptococcus was acute, sulfanilamide was prescribed in all jaw cases in which infective complications became apparent.

In the Military Surgical Manual of Standard Practice of Maxillofacial Surgery, the administration of sulfanilamide internally, and of sulfanilamide or sulfathiazole powder locally was recommended for gunshot wounds involving the jaws. For general information on the use of chemotherapy in the prophylaxis and treatment of infection, the articles by Long (126), Finland (64), Janeway (107), and Lyons and Burbank (131) are recommended. For a review of the problems peculiar to surgery of trauma, including a discussion of the latest principles of treatment, the reader is referred to an article by Rogers (166).

THE DEVELOPMENT IN THE FIELD OF INTRAORAL SPLINTS

It was natural that the methods of fixation used during World War I should at once be applied to fractures occurring during the new catastrophe.

Intermaxillary fixation by wiring still served its purpose well in simple fractures. Newer methods of wiring teeth have been described recently by Peterson (159) for cases in which individual teeth have to be wired, when contact between the teeth is lacking, and when the vertical height of the teeth is unfavorable for ordinary eyelet wiring.

Cap splints. James (106) described the latest types of open cap splints, various sectional splints, a modified Kingsley splint, the modified Gunning splint, several vulcanite block splints, and other supports to prevent contraction, occlude openings, and provide support for the tissue. McLeod and Shepard (137), in an article on cap splints, described their use for various types of fractures—for reduction by immediate tension of intermaxillary wires or by gradual elastic traction, and for manipulation under anesthesia.

Kazanjian (117), in a review of his methods employed in World War I (already described), found that the type of splints he used when on active service twenty-five years ago still gave the best service today, especially in the treatment of compound comminuted fractures of the mandible.

Acrylic splints. Acrylic block splints are used today instead of the rubber splints described heretofore. Miller (145), of the U. S. A. Dental Corps, recommended a simple basic type as well as more elaborate types for complicated fractures, such as those requiring intermaxillary traction or expansion by means of extension arms. The latter were used when there was extensive loss of tissue and resulting contraction. Linn (125) and Ferber (63) described other types of acrylic splints useful for depressing the posterior overriding fragment. Lowery (127) pointed out that in cases in which prolonged fixation was indicated, splints were especially useful. He gave instructions on how to construct various types, and also pointed out the advantage of acrylic resin; it is radiolucent and does not obstruct the x-rays when roentgenograms are taken of the teeth and bones with these splints in place.

Waldron (201, 202) concluded that for routine procedures, the employment of wiring methods rather than of dental splints was preferable because of the simplicity of application. The difficulty in obtaining good occlusion when splints were used was overcome, however, by means of the open occlusion splints made of clear acrylic resin through which the covered teeth could be observed.

Walker (205) recommended the use of arch wires if there were teeth missing in the dental arch, if the occlusion had to be corrected by traction, or if gradual reduction was to be effected. For this purpose, some ready-made splint may be used, such as the Winter splint or the Jelenko fracture splint. The former, recommended by Winter (211) in 1943, is made of an alloy which is pliable so that it can easily be adapted to the dental arch; the other is made of stiffer material and is useful particularly if more strength and support are needed. Arch wire splints are attached to the teeth by wire ligatures and are useful especially if elastic traction is to be used to correct malocclusion. The advantages were elaborated by Buxton, Parfitt, and MacGregor (30) in 1941.

Fig. 11. Irrigation with Dakin's solution (Shepard, *Brit. Dent. J.*, 1940, 69: 431).

Splint for quick release in emergency. Harper (85) described the use of the "cotter key" combined with eyelet wiring, or the continuous loop wiring of Colonel Stout. Instantaneous release was possible by simply drawing the pin on each side out of the eyelets attached to the teeth. This method is not unlike the pin and tube splint, except that it can be applied immediately.

DIRECT WIRING FIXATION OF THE FRAGMENTS

Open reduction with interosseous wiring or plating has not made any great progress as its use has been discouraged by most writers in the past (*supra*). The intraoral approach, however, which was favored by Kazanjian, has recently been championed by Shearer (179) for use in edentulous cases. He advised a wide exposure of the bone so that the entire field can be observed. Holes are drilled in the "strong part of the jaw," at least ¼ in. away from the fracture. Gordon (77), who also

recommended this method, used stainless steel sutures, reporting that in the reduction of 7 malar, 2 maxillary, and 15 mandibular fractures (1 condylar), only 3 infections occurred, 2 in the soft tissue, and 1 in the bone—a case of angle fracture developed osteomyelitis. He concluded: "Wire sutures allow accurate reduction and fixation, and control fragments that otherwise would be difficult to manage."

INTRAOSSEOUS WIRE FIXATION FOR TRANSFIXATION OF THE FRAGMENTS

In intraosseous wire fixation a Steinmann pin or a Kirschner wire is drilled across the fracture line. Multiple wires are used in multiple fractures. The method was described by Ipsen (93), Meade (142), and Søbye (183). Brown and McDowell (27, 28) stated that they found intraosseous wire fixation to be of major service in the fixation of difficult jaw fractures. They recommended it when there were an insufficient number of teeth for interdental wiring, in severe fractures to avoid complicated appliances and wide open reductions, or when it was desirable that the patient be able to open his mouth. They advocated its use also for certain maxillary fractures, the wire being inserted transversely through the cheek. Waldron (201, 202) recommended the use of a transverse Kirschner wire inserted through the symphysis to hold the mandible forward and in occlusion in bilateral fractures of the ramus, or in fractures of the condyle when the anterior teeth were loosened and interdental wiring was not practical. As in maxillary wiring, the wire ends protruding through the side of the chin, or the cheek, might be attached to a head apparatus for stabilization (Fig. 27).

EXTERNAL SKELETAL FIXATION

The basic principle of this method was originated by Parkhill (155, 156), who described a "bone clamp" for various long bones of the body. It is a method in which the fragments are controlled by means of pins or screws inserted through the skin. Roger Anderson (6) further developed this method to meet the urgent requirements of air and sea warfare, and to facilitate the evacuation and transportation of patients with securely immobilized fractures. This method was modified by Waknitz of the American Hospital in Britain to be used for the mandible. Converse and Waknitz (40) described their appliance as being particularly useful in the control of the posterior edentulous fragment. They used stainless steel wires inserted through borth cortices by means of an electric drill. In the United States, Fairbank and Stout of the Dental Corps, U. S. Army, developed the "Frac-Sure splint" which is readily adjustable to fractures of the mandible. (Fig. 12). Another variation of this type of apparatus was described by Clouston and Walker (34). It was used at the Maxillofacial Center in Basingstoke, England, by Rushton and Walker (206). After using this method, they concluded that it should be reserved for (1) multiple fractures of the edentulous or newly edentulous mandible; (2) fractures in which there is a posterior edentulous fragment which cannot easily be controlled; and (3) patients in whom it is necessary to control edentulous fragments for bone grafting.

In 1931, Stader, a veterinarian, developed an apparatus which was applied to orthopedic surgery by Lewis and Breidenbach (123). A series of 40 cases was reported by Shaar and Kreuz (177), and the application of the apparatus in question was described in their monograph (178).

Another appliance in which the pairs of pins are held in blocks is that described by Haynes (89), and its modification, the Haynes-Griffin apparatus, was described by Griffin (78). Thoma (190) wrote that the alignment of the four pins allowed only limited deviation, otherwise the adjustment bars would not fit. He stated that this can be remedied, however, by using ball socket bars on both blocks and an 11-gauge wire to make the connections (Fig. 13). This method can be used in multiple fractures when more than two pairs of pins are required.

Among other appliances for skeletal fixation is that designed by Berry (15). He developed a method of vertical implantation of vitallium screws into the alveolar ridge of edentulous mandibles, connecting them with alignment rods by means of sleeves that were fastened by wires. This method was extended (16) to extraoral application; however, it did not give as secure fixation as some of the other methods described. Bigelow (17) reported the use of screws (one in each fragment) held by a splint or incorporated in plaster; later he used screws with a slotted head to accommodate a bar held by a nut (18). It was a simple, light apparatus with the disadvantage that the alignment rod had to be bent in order to fit it into the slots, which made accurate reduction difficult.

Advantages. The advantages of skeletal fixation are numerous. Winter (211), in a report on 36 patients treated with skeletal fixation, stated that it made early and prompt reduction possible, since it required a minimum of complicated equipment. Haynes (189) pointed out that callus formation may be expected earlier, and we know that the use of a bone increases the inflowing calcium, and counteracts the atrophy that occurs from disuse.

Fig. 9. Pseudarthrosis in patient eighteen years old, who sustained a condylar fracture when nine years of age (Thoma, *Am. J. Orthodont.*, 1943, 29: 550).

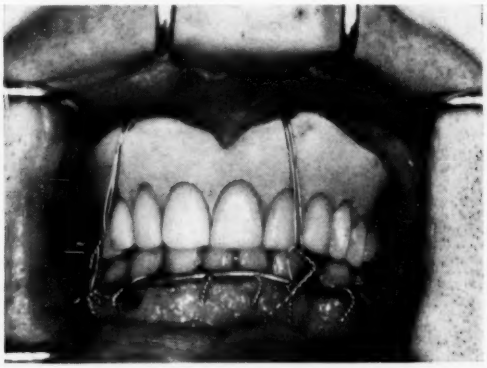


Fig. 10. Method of immobilizing mandible by internal wiring (Thoma, *Am. J. Orthodont.*, 1943, 29: 525).

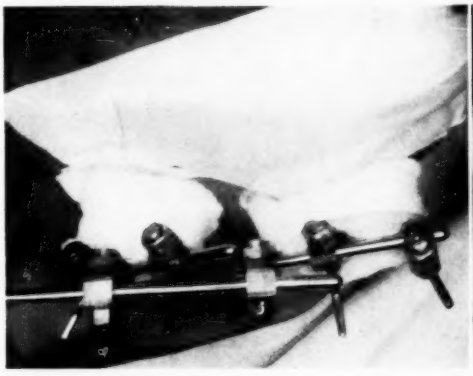


Fig. 12. Fracture of edentulous posterior ramus immobilized with Frac-Sure appliance.

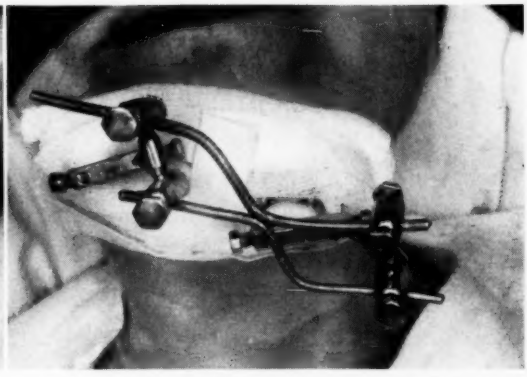
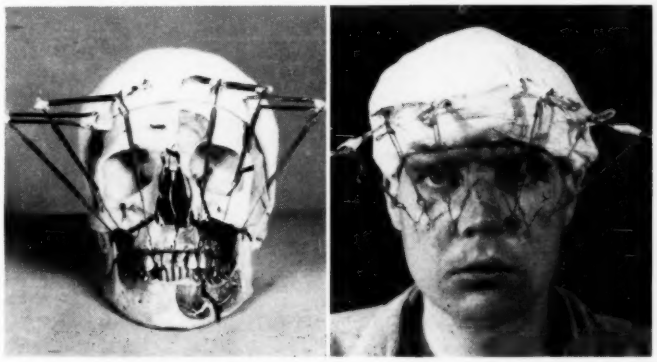


Fig. 13. Griffin appliance modified by Thoma by the use of 11-gauge German silver wire in four-ball socket bars (Thoma, *Traumatic Surgery of the Jaws*, p. 167).



Figs. 14 and 15. Dingman's method of traction for maxillary fractures (Dingman, *J. Am. Dent. Ass.*, 1939, 26: 173).

Fig. 16, left. Erich's method of traction useful for maxillary fractures to give vertical support (Erich, *J. Am. Dent. Ass.*, 1942, 29: 783).

Fig. 17. Middle-third face and mandibular fractures with cerebrospinal rhinorrhea and dilated fixed pupils, blindness in the left eye, and paralysis of the sixth nerve. After reduction the ophthalmological signs disappeared gradually and completely.

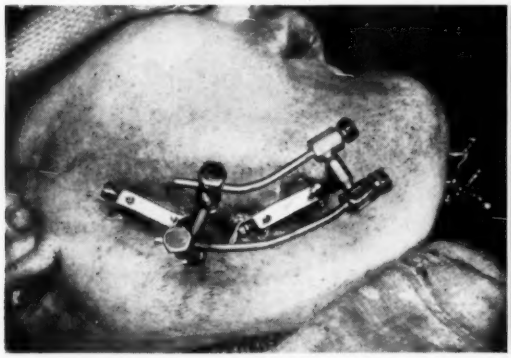


Fig. 18, left. Griffin appliance with connecting bars bent for simple mandibular fracture of edentulous mandible.

Fig. 19. Frac-Sure appliance with two pairs of pins placed far apart in an almost edentulous mandible for treating an oblique fracture with osteomyelitis at the symphysis, and a pin in each malar bone for stabilizing a fracture of the condyle by immobilization of the jaw. Note formation of triangle by connecting bars, giving greater stability to apparatus.

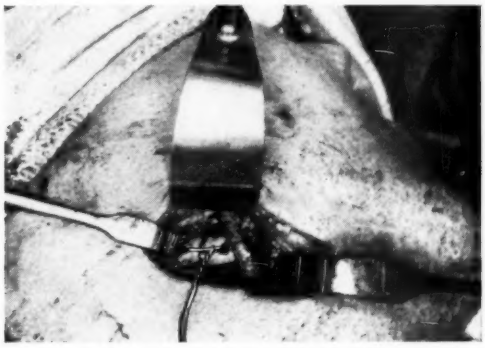


Fig. 20. Direct wiring with open reduction.

Fig. 21. Introduction of circumferential wire through hypodermic needle.

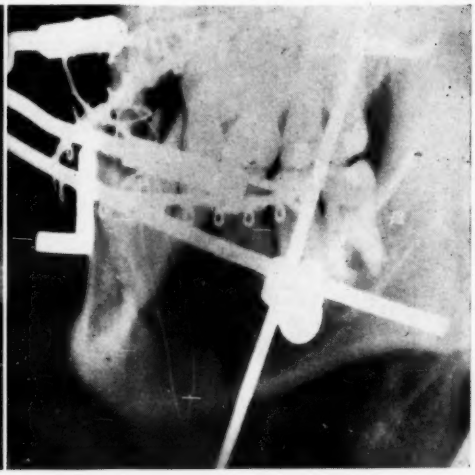


Fig. 22. Circumferential wire holding alveolar fragment in position.

Fig. 23. Intermaxillary traction with Stout's continuous wire loops, and occlusal block to overcorrect open bite in condylar fracture.

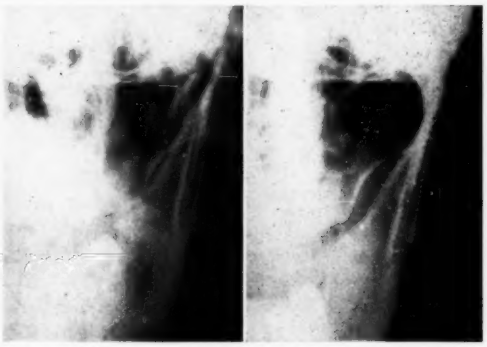


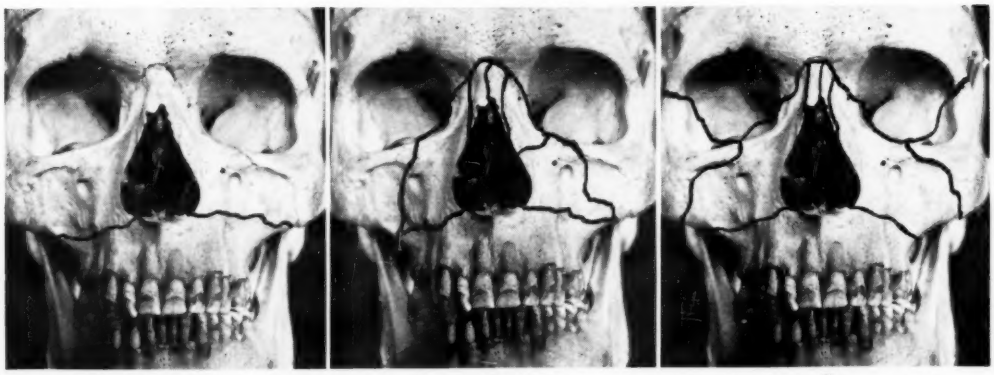
Fig. 25. Left, Fracture of the condyle, mesially displaced, with overriding. Right, After open reduction and internal wire fixation.

Fig. 24. Condylar fracture reduced and immobilized by means of pin inserted into condylle and attached to plaster cap. External traction from head cap to chin.

Fig. 26. Immobilization of edentulous mandible in multiple fractures (comminuted fracture of horizontal ramus on one side, fracture and dislocation of condyle and fracture of coronoid process on the other side, also fracture of the maxilla) by means of half pins inserted into the anterior part of the mandible and attached to rods from a head band. Note extension rod to pin in condyle. Third week after operation.

Fig. 24.

Fig. 26



A B C

Fig. 27. Three types of middle-third face fractures. A, horizontal fracture of maxilla; B, pyramidal fracture; and C, transverse fracture of face combined with horizontal fracture of the upper jaw.

Fig. 28.

Fig. 29.

Fig. 30.

Fig. 28. Patient shown in Figure 17 after reduction of fractures under intravenous anesthesia. Horizontal maxillary fracture reduced with half pins inserted into the practically edentulous upper jaw to hold it in apposition with superstructure by means of rods extended from a Woodard head band. Mandibular fracture reduced with Frac-Sure appliance, transverse facial fracture with malar bone and maxilla comminuted on left, and pyramidal fracture involving nasal bones, ethmoid, and piriform plate reduced by internal wiring. Note wire holding infraorbital margin in reduced position from rod attached to head band.

Fig. 29. Internal wiring for middle-third face fracture. Probe inserted to pass stainless steel wire looped through supraorbital ridge into oral cavity behind malar bone.

Fig. 30. Internal wiring (patient shown in Figure 28). Note wires extending behind malar bones into mouth where they are attached to Jelenko arch, and also the guide wires to facilitate removal of internal wires.

At the same time, since the joints are not immobilized, patients are not affected by muscular trismus, which so frequently prolongs the period of disability. This was pointed out by Amies (5), who stated that the use of physiotherapy had become a very important adjunct to the A.I.F. Faciomaxillary Unit at Kantara.

Application of skeletal fixation. The use of this method, most writers pointed out, should be reserved for cases in which other types of treatment are not applicable.

Gillies (72), in summing up the work at the British Maxillofacial Centers, concluded that skeletal fixation would definitely have a permanent place along with other methods. Among the disadvantages, he mentioned: (1) local necrosis, which he believed was due to corrosion of a pin wire or the heat generated when the bone was drilled; however, the area involved is very small and in a place that has no bearing on the treatment of the fracture; (2) difficulty in late reduction of a fracture; this is not actually due to ineffectiveness of the apparatus but may be due to impaction or binding of the bone fragments in a false position by scar tissue; both are conditions that can be remedied; and (3) pin-point scars which he states are easily dealt with if they should be offensive.

Waldron, Kazanjian, and Parker (203) concluded that the use of this method is indicated: (1) in badly displaced fractures of the edentulous mandible, particularly when they are comminuted; (2) in fractures behind the angle of the jaw, when the posterior fragment becomes difficult to maintain in reduced position; (3) in certain types of multiple fractures involving both upper and lower jaws, when other methods are not satisfactory because of the loss of teeth; (4) in comminuted fractures of the mandible with destruction of a section, wherein the isolated part cannot be held adequately with dental splints; and (5) when facilities for constructing dental splints are not available.

The technique of applying skeletal fixation. General or local anesthesia may be used, and, as Winter stated, the anatomical landmarks should be observed for study of the fracture, and roentgenograms should be taken from various angles. The location of the external maxillary artery and vein, the facial-nerve plexus, the mandibular canal, the mental foramen, and the parotid gland should be noted, as well as the exact location of the underlying fracture, its direction, and its displacement. Shaar and Kreuz (178) believed that seepage might occur if the pins were introduced into previously traumatized or devitalized soft tissue, or if the pins were not firm in the bone. They stated that dimpling, often seen in some cases at the pin-insertion point, might be due to seepage.

The operative procedure was well described by Clouston and Walker (34). Two operators are most desirable, and every aseptic precaution must be exercised. The landmarks are drawn on the skin while one operator inserts one hand within the mouth beneath the sterile drapings. He holds the jaw and controls the fragments to prevent further trauma while the pins are inserted by the second operator. The pins must be placed at the correct point near the lower border of the mandible, below the apices of the teeth and the mandibular canal, and far enough from the fracture line and from infection to avoid complications. Winter recommended that the pairs of pins should be inserted at an angle of 70 degrees, and in order to insert them at the correct distance he used pins with circular marks.

MAXILLARY FRACTURES INVOLVING THE MIDDLE THIRD OF THE FACE

The trend here is away from external accessory appliances for fixation of the bones of the face. Adams (2) stated that in using numerous types of extraoral appliances, including plaster head caps for stabilizing fractures, he found them all complicated and time-consuming in their preparation and application. Besides being cumbersome and uncomfortable for the patient, some were easily disadjusted and dislodged. The fact that so many different types of appliances were being used suggested that this method was not entirely satisfactory.

The fact that maxillary fractures were frequently associated with fractures of the malar-zygomatic compound was pointed out by Balkin (9), who described various methods of treatment. These fractures occurred not only in automobile and sport accidents, but also in modern warfare. The civilian population sustained these injuries as a result of aerial bombardment, and the men of the armed forces because of accidents of the mechanized divisions and the action of missiles. Erich (60) classified fractures of the middle third of the face as follows: (1) transverse maxillary fractures, in which there is a complete separation of the maxillae from the rest of the skull; (2) pyramidal facial fractures, which extend upward through each antrum to the ethmoid region and base of the nose; and (3) transverse facial fractures passing through the base of the nasal and ethmoid region and across the orbits to the zygomatic arches. Combinations of all three types might occur, and the entire middle third of the face might be a com-

minuted mass. Complete transverse fracture of the maxilla might be complicated with separation in the midline of the palate or separation of large alveolar segments.

Associated injuries in fractures of the maxillae. Statistics regarding maxillary fractures were scarce. Adams (2) reported 85 fractures of the maxilla which had associated injuries (See Table VI).

Reduction of maxillary fractures. It was stated that reduction of these fractures was found difficult, particularly as they were generally not seen until late. McIndoe (135, 136) stated that early operative interference was contraindicated in concussion or other serious complication such as cerebrospinal rhinorrhea, which was due to fracture of the cribiform plate of the ethmoid bone. Infection might lead to fatal meningitis. Erich stated that only after the fracture in the ethmoid region had become walled off by fibrous tissue (in about two weeks) was it safe to reduce and immobilize the fractured bones of the face. Otherwise it was important, as pointed out by Parker (154), that maxillary fractures, especially those with posterior displacement and with impaction from a crushing injury, be reduced as early as possible. Gillies (72), commenting on early reduction, stated that it should be performed as soon as the period of shock had passed.

Elastic traction. Traction gave excellent results in cases in which reduction had been delayed. For low horizontal fractures of the maxilla with upward and backward displacement, Thoma (190, 193) recommended reduction by intermaxillary traction with Kazanjian buttons or Jelenko splints attached to the teeth, and an accessory head bandage with elastic traction on each side over the cheek. The first effected normal occlusion; the latter aided in stabilization of the upper jaw.

For cases with downward displacement, Major (139) recommended skeletal traction in addition to intermaxillary elastics. This he applied by inserting a Kirschner wire transversely into the symphysis of the mandible. By this means a tremendous force could be applied with S-shaped hooks attached to the Kirschner wire and fastened to a head cap. A turnbuckle served to shorten the rods in order to reduce the fracture gradually. Dingman (47) recommended a method similar to that devised by Federspiel (61) for cases with downward displacement. The latter consisted of fastening a plain arch wire to the necks of the teeth from which strands of copper wire were attached and passed through the cheek to the outside of the face; then they were twisted together over a plaster head cap until the fracture was reduced. Dingman's method was to attach Winter arch bars to both the upper and lower teeth for intermaxillary traction, as well as silver wires which were passed through the cheek to be fastened with elastics to rods extending from a plaster cap (Figs. 14 and 15).

Erich (60) made an important improvement by using adjustable hooks attached to the head cap; this prevented the wires from cutting into the soft tissue and forming a scar if they did not come out of the skin exactly at the right place. In edentulous jaws Erich recommended that the wires be attached to the flanges of the patient's artificial denture or a rubber splint (Fig. 16).

Internal wiring fixation. Adams (2) wrote that until two years ago his treatment included the use of extraoral appliances, but since then open reduction and fixation by wiring of the fractured parts to the neighboring unfractured bony structures have been carried out in most cases. For this method he claimed facility of operation and attainment of complete immobilization; it followed sound surgical principles, and required easily available instruments. Repeated adjustments were unnecessary and the patient was spared the discomfort and inconvenience of head gear and rods

TABLE VI—ASSOCIATED INJURIES IN FRACTURES OF THE MAXILLAE

Year	No. of Cases	Fracture of Mandible	Fracture of Zygoma	Fracture of Nasal Bones	Fracture of Skull	Facial Lacerations	Infection with Drainage	Deaths
1934	4	1				3		
1935	8	3	3		1	6		1
1936	5	1	3	1		3		
1937	4	1	3	1	1	1		
1938	12	2	3	3		9	1	
1939	13	2	3	3	1	10		1
1940	17	2	2	4	1	11	2	1
1941	22	7	5	4	1	17	2	
Total	95	19	22	16	5	60	5	3

around his face; therefore he could resume his activity after he had recovered from the acute stage of the injury.

The method for simple horizontal fractures not involving the orbit consisted in passing a stainless steel wire, No. 25 or 26, through a small hole made in the infraorbital ridge through a short incision. The wire was passed along the anterior wall of the antrum under the skin, through the mucosa of the upper sulcus, buccally, to the second molar. After the fractured bone was placed in position, the wires were fastened on each side to an arch band attached to the necks of the teeth. Intermaxillary elastics might be applied if the occlusion needed to be corrected, or in case of multiple fractures.

If the fracture involved the zygoma or infraorbital ridge, the wire was inserted into the supraorbital ridge just above the zygomatic-frontal suture. Through a short incision, a small hole was drilled at this point; through this the wire was inserted and looped over the ridge to be passed beneath the temporal surface of the malar bone. This was best done by means of a bent, malleable dissecting probe, the eyelet of which served to carry the wire into the mouth through a small incision in the reflection of the mucosa. If immediate reduction was possible, the wires were attached, one on each side, to an arch band fastened to the upper teeth (Fig. 29), or if the patient wore artificial dentures, to the outer flanges of the latter. These wires were removed by cutting the loop at the place of insertion and drawing them down into the mouth, so as not to introduce infection into the face.

In fractures involving the displacement of the malar bones, Adams advised the use of stainless steel wires, passed through holes made in each fragment near the fracture line. This would reduce the fracture and hold the bone in normal position. Gordon (77) has reported the reduction of 7 malar fractures by this method.

Conclusion

Ten Commandments for the Care of Patients with Injuries of the Face and Jaws

Since the material presented in this review is almost exclusively an expression of the opinion of those who have written on the subject, and because some of these opinions are controversial, I shall conclude this paper by setting forth some of the principles which I believe are important in the treatment of fractured jaws.

The following are 10 commandments to be observed in the treatment of fractured jaws:

I. Treat the Patient

The patient's general condition should be considered first. Serious accidents are generally associated with shock, which may be over within ten hours, and secondary shock which may supervene several hours later. Shock generally is caused by hemorrhage and loss of fluids from wounds in compound fractures, and from burns. Shock in combat zones is aggravated by fear, anxiety, hunger, and lack of rest.

The treatment consists in placing the patient in a recumbent position, bed rest as soon as possible, maintaining body heat, and reducing pain with morphine unless contra-indicated. Immediate transfusion of saline solution or plasma should be given, and hemorrhage should be stopped. A blood transfusion before an extensive operation is helpful to debilitated patients. Care should be taken that unskillful handling and rough transportation does not cause secondary hemorrhage. To prevent this, bandages and prophylactic splints should be applied.

II. Attend to Soft-Tissue Wounds

First aid should consist in control of hemorrhage or oozing by means of pads of sterile gauze bound in place with a bandage, such as a cravat or four-tailed bandage. Sulfanilamide may first be dusted into and on the wound. If it is not available, a solution of merthiolate or zephiran may be placed in and over the lacerations. Badly lacerated wounds should not be sutured in compound fractures, until at least temporary fixation of the fractures has been accomplished, because traction caused by the skin may produce marked displacement, and movement of the fragments may cause hemorrhage and hematoma under the skin with resulting infection requiring incision and drainage. Advanced fracture treatment consists of the removal of foreign bodies, detached pieces of bone, and fractured teeth. Irrigation with saline solution is advantageous, but débridement should be carried out with restraint.

III. Make a Careful Clinical Examination

A thorough history of the accident should be taken either from the patient or an observer. The cause of the injury may give important information and become a guiding factor in treatment; one should know the type of foreign body that may have entered the tissue, and the character of contamination that may therefore be expected. It is important to find out whether immediate unconsciousness for any length of time followed the accident. Unconsciousness points to concussion or contusion of the brain. If the patient had an

interval of consciousness preceding unconsciousness, a hemorrhage probably is the cause. In such cases unconsciousness generally deepens. In very severe injuries there may be laceration, and in both contusion and laceration there is blood in the cerebrospinal fluid. Fractures of the skull should be suspected and looked for; these may involve the vault or the base of the skull. The fracture of the base is more serious than fracture of the vault, because vital parts may be endangered. Fractures involving the middle cranial fossa may be due to the fact that the mandibular condyle has been forced through the glenoid fossa by a blow on the chin, or to fracture of the petrous portion of the temporal bone. In such cases, hemorrhage or cerebrospinal fluid may be discharged from the ears, the facial and auditory nerves may be injured, and the optic nerve may be involved with resulting blindness. In fractures involving the anterior fossa, ecchymosis of the lids occurs with subconjunctivial hemorrhage if the orbital plate of the frontal bone is broken; however, this sign may be due also to fracture of the malar bone, especially when it involves the external or inferior border of the orbit. If the cribiform plate is fractured, hemorrhage or cerebrospinal fluid will escape (Fig. 17) from the nose (cerebrospinal rhinorrhea), and hemorrhage may be found beneath the pharyngeal mucosa. Conjunctival hemorrhage with ecchymosis mainly involving the suborbital area indicates a transverse facial fracture with involvement of the infraorbital ridge.

Ophthalmological signs are of importance. Failure of the pupils to react is a bad sign; unilateral dilation and fixation of the pupil (Fig. 17) draws attention to the side where the intracranial injury has occurred. Blakeslee (22), in a comprehensive study of 595 cases at the Harlem Hospital in 1929, showed that the mortality was 95 per cent in patients exhibiting bilateral dilated and widely fixed pupils, while it was 50 per cent in those with one fixed and dilated pupil. Diplopia is generally due to downward displacement of the eye, which indicates destruction of the floor of the orbit and comminution of the maxilla in general. Other eye manifestations of head injuries have been described recently by Lyle (128).

Neurological signs should be carefully recorded. Injury of the facial, the abducens, the auditory, the motor oculi, and the optic nerves may occur. If they are compressed by edema only or by displaced bone, the paralysis may be temporary; if the nerves are completely severed, it will be permanent. Divisions and branches of the fifth nerve are frequently affected. The area of anesthesia should be carefully noted. In lateral mandibular fractures numbness of the lower lip and chin is common; in fractures of the middle third of the face, the numbness may affect the nose, infraorbital region, upper lip, and, more rarely, the hard and soft palates.

IV. DETERMINE THE TYPE AND EXACT LOCATION OF THE FRACTURE

Deformity caused by a fracture should be observed and differentiated from soft-tissue swelling. The mobility of the bone should be tested by bimanual manipulation of the mandible, by introducing two fingers into the mouth and taking hold of the upper jaw, by palpating the region of the mandibular joint in front of the tragus of the ear, and by feeling the orbital ridge. Crepitus may or may not be present. It is not wise to manipulate excessively because this may cause new hemorrhage or dislocation. The occlusion and condition of the teeth should be carefully observed, especially should luxation and fracture of individual teeth or entire segments be detected. The relation of the upper to the lower denture often gives important information. Open bite is seen in condylar fractures and horizontal fractures of the maxilla. Retrusion of the maxilla is seen in middle-face fractures, retrusion of the mandible in bilateral condylar fractures. Deviation of the jaw generally indicates unilateral fracture. Displacement of fragments interferes with occlusal contact of the teeth.

Roentgen examination is indispensable. Its routine use saves much time for the diagnostician and discomfort to the patient. It should include views from various angles: anteroposterior and posteroanterior views, lateral skull, and lateral jaws showing the horizontal as well as the vertical rami including the condyle, and views from Water's position and exaggerated Water's position as indicated. Dental films should be taken if possible to disclose injury and infection of the teeth. Stereoscopic x-rays are of great help in locating foreign bodies, especially if indicators are previously inserted into the tissue.

V. PREVENT AND TREAT INFECTION

Simple fractures of the jaws do not generally present serious problems of infection. In compound fractures, thorough, although conservative débridement of the soft-tissue wound, including the removal of foreign bodies, irrigation, and early immobilization greatly minimize the incidence of infection. The local application of 1 part sulfathiazole and 2 parts sulfanilamide is recommended. If there are intraoral wounds, the presence of Vincent's infection should not be overlooked. If

fractures are compounded into the mouth, a smear should be taken if the gingivae look suspicious. Chemotherapy by intravenous administration, 5 gm. of sulfadiazine in 100 cc. of sterile distilled water, or by the oral route, 2 gm. of sulfadiazine given at once and 1 gm. every four to six hours, should be instituted in all compound fractures and in all cases in which there is a hemorrhage from the ear, or in which cerebrospinal rhinorrhea is present. A blood level of from 6 to 8 mgm. per 100 cc. should be maintained. In staphylococcic infection the use of sulfathiazole may be found more satisfactory. Penicillin when freely available may be found to be an improvement over the sulfonamides. Advice regarding its use is given by Lyons (129). My experience is limited to 1 case—that of a septic fracture in which excellent results were obtained with penicillin after all other methods had failed. Supportive treatment should be given as indicated. Serious local infections may come from wounds of the face or in the mouth, since all face and jaw wounds are potentially infected. By far the greatest source of infection comes from teeth involved by the fractured bone. Any fracture through an alveolar socket or an impacted tooth should be considered a compound fracture which may be the cause of complications that manifest themselves as cellulitis, abscess formation below the fracture line, and, later, osteomyelitis. Any persistent and progressive inflammatory process with fever is generally due to lack of drainage. Hot fomentations should be applied, and incision and drainage are indicated if pus causes fluctuation, in the case of osteomyelitis, and even if there is only a fracture hematoma beneath the jaw. A persistent fistula is due to the presence of either a sequestrum or a nonviable or infected tooth. Delayed union or nonunion is frequently caused by teeth which are allowed to remain in the fracture line.

VI. SECURE TEMPORARY IMMOBILIZATION

Frequently the injured cannot receive adequate treatment of their jaw fractures at once. This is certainly the case in the combat zones. In civil practice also, a delay may be necessary because of other severe injuries or complications. In such instances, temporary reduction and immobilization of the fracture will decrease the danger of secondary hemorrhage and infection, relieve pain and shock, and prevent disfigurement.

VII. CHOOSE THE CORRECT TYPE OF ANESTHESIA

The choice of anesthesia depends on many factors. Simple fractures without complications may be reduced under local anesthesia, a combination of conduction and infiltration methods. Local anesthesia should also be used in patients suffering from shock, or those who are in poor physical condition from other causes. General anesthesia, however, is more desirable when the surgical procedure is complicated by contusions and lacerations about the mouth, when muscular relaxation is desirable to reduce the fractures, and when multiple fractures are widely distributed. Intravenous anesthesia has many advantages in patients in good physical condition. Contraindications are shock, anemia, cyanosis, pulmonary disorders, and respiratory obstruction. It has the advantage of quick induction, and is followed by a minimum of nausea and vomiting. Endotracheal administration of ether is probably the safest type of general anesthesia, and should be used if the intravenous administration of pentothal is contraindicated. The endotracheal tube may be inserted through the nose, to administer the anesthetic or to prevent aspiration of mouth secretions. If intravenous anesthesia is used, it is possible to pack the oropharynx completely. Preanesthetic sedation should be used in all cases. It frees the patient from apprehension and decreases the amount of anesthetic needed.

VIII. GIVE ATTENTION TO PROPER REDUCTION

A great deal has been written about the apparatus and methods for the immobilization of fractures, and very little about methods of reduction. Fresh fractures generally are reduced easily by manipulation. It may be necessary to disimpact the fracture against muscle pull; in such cases general anesthesia is helpful because it causes muscular relaxation. In all, but especially in oblique fractures, distraction must be guarded against. It may be due to interposition of a splinter of bone, soft tissue, an organized blood clot, or a foreign body. The bones must be approximated properly. Accurate reduction can be achieved only by intraoral and external manipulation, and by palpation of the surfaces of the bone. The position of the distal fragment as well as of the proximal fragment, and the occlusion of the teeth must be carefully checked.

Late reduction of fractures that are from one to two weeks old may still be accomplished by traction. Later, if strong fibrous or bony union has occurred with the fragment in malposition, corrective osteotomy is the only procedure that allows realignment. It can be performed in the mandible as well as in the upper jaw. Sometimes a sliding osteotomy is needed to lengthen the lower jaw if it has been shortened by loss of substance.

IX. SELECT THE BEST METHOD OF FIXATION

A well considered decision must be made in the choice of the method of fixation. In single fractures this is not difficult, but in multiple mixed fractures a great deal of careful planning is required, and some combinations of fractures of the middle and lower parts of the face tax one's ingenuity. Each case must be decided upon its own merits, the magnitude of the injury, the availability of apparatus, the facilities for operative procedures, and the experience of the surgeon; all play a determining role. I favor the surgical approach; it eliminates many dental procedures which are time-consuming and expensive, often delay reduction for days, and do not always bring about accurate results. The construction of splints requires a dental laboratory and technician, which are not easily available to the oral surgeon working in a hospital. In unusual cases, however, they may be absolutely necessary (comminuted fractures, bone grafting). A good general rule is to use the simplest method by which it is possible to accomplish adequate reduction and fixation.

Skeletal fixation, although not as yet out of the experimental stage, has already proved itself a great adjunct to the armamentarium available for fracture treatment. The Haynes-Griffin appliance, while having the advantage of great stability, presents certain difficulties in its application. The pins must be placed parallel to each other and at an unalterable distance apart, otherwise the blocks cannot be attached to them. Furthermore, the pairs of pins must be approximately in alignment, because the connecting rods allow only moderate disalignment. Bending them (Fig. 18) or replacing them by German silver wire (Fig. 13) facilitates the use of this appliance. The Frac-Sure appliance, on the other hand, is very adaptable. It can be used in any situation or in any combination. Pins may be inserted wherever they are most needed, and at an angle which will give the most support. When the pins are far apart, additional connecting rods can be applied to give the appliance greater stability (Fig. 19).

The advantages of skeletal fixation have been adequately described, as well as the technique of application. Some surgeons insert the pins by hand, either with a screw bit or with a hand drill. I prefer to drill a hole with an electric dental engine. It eliminates the pressure which otherwise must be applied to insert the pins, and which may cause displacement of the fragment. I use a spear-shaped drill to make the hole, and keep my fingers on the skin over the jaw while changing from the drilling to the insertion of the pin. Care must be taken, however, not to overheat the bone; the drill should be turned slowly, or cooled with water while it is being used, and a new drill should be used for each hole.

After the pins are inserted other surgical procedures that may be necessary, such as sequestrotomy, extraction of teeth, removal of foreign bodies, excision of scar tissue, incision, and drainage, should be done. Next comes the reduction of the fracture by manipulation inside and outside of the mouth until the correct anatomical position has been achieved; then all connecting bars are attached and all nuts are very securely tightened.

While one of the advantages of skeletal fixation is avoidance of intermaxillary fixation, the same apparatus may be used to immobilize the jaw; this is often necessary in fractures of the condyle or of the maxilla and can be done by attaching the mandibular appliance to pins inserted into the malar bone (Fig. 19), or to a head band or plaster cap (Fig. 25).

The following outline may be of value to the reader:

A. Fractures of the Mandible.

1. Single or multiple fractures within the dental arch are generally reducible by intermaxillary wiring by the Gilmer or the eyelet methods. In old fractures with displacement, elastic intermaxillary or interarch traction may be needed; the former is applied by means of the Jelenko or Winter arches, the latter according to Moorehead. If the fractures tend to displacement after reduction, skeletal fixation may be a help. This method should also be used if immobilization of the jaw is undesirable or contraindicated.

2. Single or multiple fractures with an insufficient number of teeth for intermaxillary wiring may be treated by intermaxillary ligation with Gilmer arch wires attached to anchor teeth with Angle bands. More satisfactory results are obtainable by skeletal fixation, especially in cases of multiple fractures and fractures with displacement due to muscle pull, or if the teeth needed for anchorage are questionable or actually involved in the fracture and therefore are to be removed.

3. Single or multiple fractures with one fragment edentulous. These fractures are very common; generally the edentulous fragment consists of the vertical ramus with more or less of the horizontal ramus attached to it. The horizontal part may contain an involved tooth which has to be extracted. In these cases a splint with an extension arm (especially useful in children), a wire looped through a hole drilled into the angle of the jaw and connected to a bar extended from a head cap, are used by many. They are not fool-proof

because adjustment is difficult, and they often become disarranged. Posterior, medial, and external displacement cannot easily be controlled. Skeletal fixation gives good results, although the vertical ramus, being very thin near the angle, does not give as good an attachment as the horizontal ramus of the mandible. The use of skeletal fixation in bilateral fractures at the angle is inadvisable, because difficulty in positioning the head when sleeping is apt to cause displacement. I prefer wire fixation by means of an open internal operation (Fig. 20), as the result is much more accurate than that gained by any other method. I consider the danger of necrosis from the drill hole of little consequence; it is not more serious than that which occurs if a drill hole is made to attach a traction wire. Intraoral direct wiring may be advisable in some instances, such as cases with cellulitis and submandibular infection. It may also serve in comminuted fractures, but according to my observation, the results obtained are not as accurate as those secured by the cutaneous approach, especially in oblique fractures with the tendency toward displacement.

4. Simple or multiple fractures in edentulous jaws, when within the coverage of an artificial denture, may be reduced and stabilized by placing circumferential wires around the jaw and over the inserted denture. If no denture is available, a simple splint fitting over the alveolar ridge may be made from an adjusted impression. The wires (stainless steel) are placed on each side of the fracture and are easily introduced by means of a long, curved, 14-gauge hypodermic needle (Fig. 21). Sometimes in single, lateral fractures, a wire must be placed on the opposite side to balance the denture. Accurate reduction of edentulous mandibles without the use of an intraoral splint is not easy. Skeletal fixation is very useful, especially in cases in which the reduction accomplished solid impaction of the fragments. In mandibles with alveolar atrophy, direct wiring should be undertaken only from an extraoral approach. Intraoral wiring in fractures of the horizontal ramus often causes injury to the mandibular nerve and does not prevent displacement. The use of intraosseous fixation by means of Steinmann pins may give good results in fractures that are not compounded either into the mouth or to the outside of the face, if the pin can be successfully guided, as described by Pincock (160). I do not think, however, that the method should be used if the x-ray findings indicate that the mandibular nerve may be accidentally injured by the procedure.

5. Comminuted fractures of the jaw present so great a variety of problems that no simple rules can be laid down regarding their treatment, except that one should always attempt to save all fragments of bone unless they are completely detached, or are about to be sequestrated. Open extraoral reduction and direct wiring in general have been condemned by everyone. In a very recent article, however, Gordon (77) made a plea for using wire sutures again, since today the availability of stainless steel gives us a nonirritating metal from which better results may be expected. He reported the results of wiring in 24 patients, 15 with mandibular, 2 with maxillary, 7 with malar, and 1 with condylar fractures. Nevertheless—and this is important—all wired mandibles should be immobilized by some form of intermaxillary fixation, such as wiring, a Gunning splint, or skeletal fixation. Perhaps many failures in the past have resulted from ineffective immobilization rather than from the method per se. Skeletal fixation may aid greatly in some comminuted fractures, although in war injuries Kazanjian's method of fixation to a bar splint (Fig. 2) has given excellent results.

In order to fix large detached fragments of the alveolar process or of the inferior border, circumferential wiring has been found very useful; I often resort to it without the use of a splint over the alveolar ridge, applying the wire subgingivally (Fig. 22).

6. Malunited fractures of the mandible often are associated with considerable physical and mental suffering. Their treatment, which cannot be included in this paper, involves a combination of osteotomy and bone grafting. Neurological complaints can often be relieved by nerve repair.

7. Fractures of the mandibular condyle are not to be considered unimportant. I know that the result of the present treatment is not as satisfactory as many who have written on this subject believe it to be. The minimum conservative treatment should be as follows:

Two weeks of intermaxillary traction in the incisor region with an occlusal block from 2 to 4 mm. wide, interposed between the last teeth (Fig. 23) to overcorrect the open bite, and three additional weeks of intermaxillary fixation without the block. In most cases, this gives a fair result which is dependent on the amount of displacement of the neck of the condyle and the character of dislocation of the joint, if present. In the treatment of badly displaced or dislocated condyles one should make an effort to draw the condyle up into the glenoid cavity and hold it there while the rest of the mandible is put into correct position by intermaxillary wiring or traction. This sometimes can be accomplished by inserting a pin into the neck

of the condyle, which in turn is attached to a rod extending from a head gear by means of a Frac-Sure bar (Fig. 24). The pin also serves to manipulate the condyle so as to correct the forward, medial, external, or posterior displacement. If possible, the condyle should be impacted against the ramus before intermaxillary ligation is applied. Since this is very difficult, open reduction is preferable, although this method requires experience and familiarity with the field of operation. The fracture may be reduced by inserting a lever (I find a small bone file, serrated on one side and smooth on the other, an ideal instrument for this purpose) between the fragments, and fixed by a 25-gauge stainless steel wire inserted through oblique holes drilled from the outer surface to the center of the fracture surface, as described in my monograph (190), and illustrated in Figure 25.

Condylar fractures in patients with edentulous jaws require special methods for immobilization. A Gunning splint can be made, or the dentures may be used to improvise one. A bandage may be applied to hold the mandible in position against the splint or dentures. This form of stabilization is not always effective and a bandage is sometimes contraindicated when other major fractures involve the horizontal ramus. Waldron's use of a Kirschner wire through the chin, attached to a head band, may be applicable, with or without dentures. In patients with a maxillary denture only, my method (Thoma, 194) of fixation by passing stainless steel wires through the margin of the piriform nasal aperture and over the inserted denture to an arch wire attached to the mandibular incisors may be used (Fig. 10), or these wires may be attached to circumferential wires in the canine region passed around the mandible carrying a lower denture. Another method accomplishing the same thing consists in placing a half pin into the mandible, on each side of the chin if possible, and fastening it to the head gear (Fig. 26). Inserting half pins into the malar bones and connecting them to a skeletal appliance attached to the mandible may also serve a similar purpose (Fig. 19). The last two methods will not only prevent the patient from moving the jaw, but will accomplish immobilization without the use of a denture splint, so that wounds in the mouth are freely accessible. Also, there is no interference in drinking a liquid diet, nor in the case of vomiting.

B. Fractures of the Middle Third of the Face

Fractures of the middle third of the face are generally much more serious than mandibular fractures, especially when associated with concussion, brain laceration, and/or fracture through the base of the skull. With cerebrospinal rhinorrhea or otorrhea and hemorrhage, manipulation of the facial bones should not be undertaken until it is safe. In such injuries, therefore, treatment is often delayed until reduction by manipulation is no longer possible. Reduction is frequently delayed unnecessarily, however, because of lack of cooperation between various departments in a hospital. Blindness and paralysis due to impingement on motor nerves often disappear miraculously if the displaced fractures are successfully reduced, while fibrous union may prevent this accomplishment if reduction is delayed too long.

1. Horizontal fractures of the maxilla through the maxillary sinuses (Fig. 27A), and simple fractures of the maxillary alveolus are generally reduced easily by intermaxillary ligation, or in late cases, by traction to bring the backward displaced maxilla into normal occlusal relationship. A Barton bandage with elastic reinforcement or its equivalent should, in addition, be applied around the head. If the walls of the sinus are comminuted, the sinus should be opened through the canine fossa, entirely detached pieces of bone removed, and other pieces pressed into position and held with a strip of boric gauze placed into the cavity but allowed to extend through the incision for easy removal. An improvised Kingsley splint attached to a head band may be used if intermaxillary fixation is not practical.

2. Pyramidal fractures (Fig. 27B) involve, in addition to the maxilla, the nasal and ethmoid bones, and often the vomer and nasal septum. The cribiform plate may be fractured and allow cerebrospinal fluid to run from the anterior cranial fossa out through the nose. Patients with this sign have a poor prognosis, and should not be carelessly manipulated.

3. Transverse fractures of the face (Fig. 27C) involve the malar as well as the nasal bones. The entire middle part of the face may be pushed back as much as ½ in., which causes not only a dish-shaped face, but also hemorrhages into the palate, pharynx, antra, and conjunctiva, and impingement on important nerves (optic, and motor nerves of the eye), as well as diplopia through disarrangement of the floor of the orbit due to comminution of the maxilla. The orbital margin may be disaligned because of fracture of the processes of the malar bone and of the maxilla. This is generally associated with marked swelling of the eyelids and ecchymosis (Fig. 17).

Early and accurate reduction of transverse fractures of the face is very important for the elimina-

tion of the complications enumerated, and to restore facial appearance. It should be undertaken as soon as complications permit. If all or most of the teeth are present, and there is no horizontal fracture of the maxilla, establishment of the correct interdental relationship may accomplish reduction of the facial fracture. Intermaxillary traction may be needed or external traction may have to be applied either with an arch wire attached to the maxilla, or by means of eye screws inserted into the displaced malar bones, the traction being applied from rods extending from a head cap or band. The infraorbital margin, if displaced, should be held in position with a wire looped around it and attached to another rod from the head appliance (Fig. 28). The walls of the maxillary sinus should be decompressed and held in place by an antral pack.

In combinations of the three types of fractures of the middle third of the face, the intraoral horizontally detached fragment of the maxilla may have to be fixed to the superstructure by means of a winged reversed Kingsley splint or a Gunning splint. In partially or completely edentulous maxillae a Steinmann pin, placed transversely through the face above the reflection of the mucosa, as recommended by Brown and McDowell (*supra*) may give good results. I think half pins inserted through the cheeks on each side as far as the hard palate are better, because if one has to be removed for any reason, the other will hold. Bars are used from a head cap to complete the fixation (Fig. 28).

Internal wiring, as recommended by Adams (*supra*), brings us a great step forward in the treatment of these cases, as it eliminates the cumbersome Kingsley splint and the easily dislodged head gear so often the cause of pressure sores. With this method the maxillary intraoral fragment is held in contact with the superstructures by means of the wires looped through the supraorbital ridges (Fig. 29) or infraorbital margins. The wires from the supraorbital ridges passed behind the malar bone may also be used to bring the entire middle-face fragment forward either by pull when reducing the fracture, or gradually by means of elastic traction. In such cases the supraorbital wire is attached to the arch band applied to the mandibular teeth and is tightened every day until the reduction is completed (Fig. 30). If infraorbital wires are used, they may be attached to an arch bar fixed to the upper teeth, and intermaxillary fixation is not needed unless malocclusion exists and has to be corrected. In order to remove the internal wire loops easily, guide wires may be attached to one strand and allowed to project through the incision. These make it easy to locate the subcutaneous wire in order to cut it and withdraw it through the mouth.

C. Mixed Fractures

Multiple mixed fractures involving the middle third of the face, as well as the mandible, have, in the past, presented difficult problems in treatment, because in most of the established methods the solid opposite jaw has been used as a splint to stabilize the bone; but if both jaws are broken, there is no stability in either part.

With the use of skeletal fixation, transfixation with Kirschner wires, Steinmann pins, and internal wiring methods, the problem becomes easier because these newer methods make it possible to fix the mandible independently so as to use it as a foundation upon which to assemble the upper jaw; this, in turn, can be brought into proper relation with the adjoining parts by means of wire sutures. All of this is not necessarily accomplished at a single operation. Two or more procedures may be required for the complete result. A patient showing a combination of various reduction methods is shown in Fig. 28.

X. GIVE PROPER ATTENTION TO AFTER-CARE

The postreduction care is of great importance. Bed rest is needed in all cases, and after long operative procedures, dehydration must be counteracted by the intravenous administration of saline solution or plasma. Measures should be taken to alleviate pain and discomfort. Malunion and nonunion may result if the fixation is disturbed, if infection sets in, or if the general health of the patient fails. Postoperative roentgenograms should be taken to check the reduction and the process of healing. In all compound fractures, or in cases in which infection of the soft tissue or bone has already occurred, chemotherapy should be used and checked by determination of the blood level obtained. The temperature chart and the white count should be carefully watched. If abscesses develop, they should be promptly incised and drained, and wounds and dressings must be carefully attended. A blood count should be taken, anemia treated if present, and the diet controlled, especially with regard to vitamins and calories. Blood transfusions, when indicated, are very helpful. The weight of the patient should be maintained, and if there is any indication of vitamin C deficiency, ascorbic acid should be prescribed. The hygiene of the mouth must be attended to with care, by spraying and rinsing. Good general nursing is of extreme importance. When finally the apparatus can be removed, it may be wise to restrain the movement of the jaw

for a week or ten days by applying one or two intermaxillary elastics on each side. After having been completely immobilized, the jaw may have become stiff as a result of muscle spasm; in this case exercises and massage should be ordered. Bandages are used only as an accessory aid in holding dressings and in preventing opening of the jaw. They must be carefully applied so as to do no harm by displacing the fragments.

SUMMARY

A review of the treatment of mandibular and middle-third face fractures in the period from the first World War to World War II has been presented. Ten commandments for the modern treatment of single, multiple, and comminuted fractures, and mixed fractures distributed over the entire facial skeleton have been given. The use of Kirschner wires or Steinmann pins has been indicated; application of the internal wiring methods has been described; and the use of mechanical skeletal fixation has been outlined. These newer methods should be looked upon as aids in solving the many difficult problems that constantly present themselves; however, they should be used only in cases in which simple, more conservative methods are likely to be inadequate. It should be understood that success with these methods depends not only on the experience but also on the skill and judgment of the surgeon who uses them. All these newer methods are still in the stage of development and improvements and new applications may be expected.

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ABSTRACTS OF CURRENT LITERATURE

SURGERY OF THE HEAD AND NECK

HEAD

Holbourn, A. H. S.: Mechanics of Head Injuries. *Lancet*, Lond., 1943, 245: 438.

The author, a research physicist, has made certain studies in connection with the mechanics of head injuries which depend on the physical properties of the skull and brain. These physical properties and Newton's laws of motion are those which determine the injury. With consideration of these factors, it has been found that there is localized injury due to distortion of the skull and injury of the brain due to rotation from shear-strain. The skull-brain system has five properties when viewed from the physical standpoint:

1. The brain is of comparatively uniform density.
2. The brain is extremely incompressible; for example, it would take about 10,000 tons to compress the brain to half its volume.
3. The brain offers very little resistance to changes in shape as compared with the great resistance it offers to changes in size.
4. Compared with the feeble rigidity of the brain, the rigidity of the skull is very great.
5. The shape of the skull and brain is important in deciding the location of injuries. There is a sixth factor which must be considered—shear-strain. Substances with a large modulus of rigidity are little affected by shear-strain, whereas structures with a small modulus of rigidity, such as the brain, are much more affected by it. Shear-strain, or slide, is the type of deformation which occurs in a pack of cards when it is deformed from a neat rectangular pile into an oblique angled pile.

In injury to the skull, distortion at the point of impact is the most characteristic feature. When fracture does not occur, the shear-strains in the brain are mainly confined to the region immediately subjacent to the blow; when fracture occurs, shear-strains are set up in the brain in the vicinity of the fracture, but mainly superficially. There are other kinds of shear-strains produced on the brain by changes in velocity of the brain itself and by the blow which sets up the motion. The change in velocity of the brain may be in a linear direction, as well as a change in velocity about some axis, i.e., there is a change in rotational velocity. An analysis of these shear-strains is discussed in the article and the areas of maximum injury to the brain substance were found to be predictable from an analysis of the location and direction of the blow and from the physical properties of the brain previously mentioned. In fact, gelatine was used to make a model of the brain which was set up in a paraffin wax skull, and by appropriate means experimental blows were produced to cause deformation in this jelly-like mass. These deformations were strikingly similar to those seen in human brains following injuries of certain types, and they are said to be caused by the shear-strains predicted for this particular set-up. The effects anticipated presented a great similarity to the injuries to human brains as described by CourVille. These factors are also believed to be significant in consideration of the problem of concussion and of the effect of bullet wounds on the head. The author refutes the notion of so-called contra-coup injuries by considering these lesions to be due to hitherto unlocalized shear-strains.

The article is of considerable importance to those interested in the mechanics of injuries to the skull and its contents, and to those interested in the problem of concussion. There seems to be considerable agreement between theoretical predictions and observed facts, and the author believes that only minor alterations will be necessary to explain quantitatively the usual type of accident.

ADRIEN VERBRUGGHEN, M.D.

EYE

Bedell, A. J.: Epidemic Keratoconjunctivitis. *N. York State J. M.*, 1943, 43: 2049.

The author reports 6 cases of epidemic keratoconjunctivitis. He points out that in the acute stage, keratoconjunctivitis usually involves the entire conjunctival surface. The eyelids may be swollen and edematous. The conjunctiva may be only slightly congested and may present large or fine follicles, or it may be edematous, and a membrane may or may not be present. Following the acute stage, a period may occur in which the eye is quiet. This period may be followed by a severe exacerbation accompanied by dimness of vision resulting from infiltrates in the cornea.

The earliest symptom is a foreign-body sensation associated with lacrimation and little or no purulent secretion. Examination reveals superficial minute pin-point depressions in the epithelium, or comma-like epithelial loss followed by corneal infiltrates. The corneal changes are evanescent and may not stain because they are situated beneath the epithelium. The infiltrates are situated in Bowman's membrane or in the contiguous layers of the cornea. Usually they are located in the interpalpebral area of the cornea, and they are especially numerous in the region farthest from peripheral nourishment. Their consistency varies from a few granules to thick grayish-white plaques. The infiltrates are avascular and do not coalesce. The iris is not affected.

Thygeson attributes the disease to a virus. Bedell does not consider glandular enlargement as an essen-

tial criterion, but Sanders, Thygeson, and Braley consider it an important diagnostic criterion. The terms "welder's disease" and "shipyard conjunctivitis" are condemned.

Atrophine, dionine, nitrate of silver, and other silver salts are of no value. The author recommends frequent instillation of 5 per cent aqueous solution of sodium sulfathiazole; a 1 to 1,000 solution of adrenaline chloride; holocaine, pontocaine, and similar drugs; either hot compresses or ice packs; and a high caloric diet and vitamins. Serum therapy has not been very successful. There is no specific cure, and although the spots may not disappear, vision gradually returns to normal. To prevent transmission of the disease, it is advisable for the patient to stay away from work during the acute stage.

It is pointed out that corneal infiltrations may follow a remission in the acute symptoms even as late as forty days after apparent recovery. They may remain unchanged for months, or may never disappear.

Keratoconjunctivitis should be differentiated from keratitis superficialis, herpes cornea, herpes zoster, keratitis disciformis, Beal's conjunctivitis, acute catarrhal conjunctivitis, conjunctivitis associated with nasal infection, dacryocystitis, nummular keratitis, and from deposits on the posterior surface of the cornea. JOSHUA ZUCKERMAN, M.D.

EAR

Lodge, W. O.: Preventive Treatment of Chronic Otitis Media. *J. Lar. Otol.*, Lond., 1943, 58: 243.

Chronic otitis media usually has its origin in childhood and preventive measures should be taken at that period if normal hearing is expected later.

It is probable that many children with adenoids who are suffering from deafness have simple retention of fluid in the tympanum.

The endaural approach to the mastoid has increased otological surgery and has enabled the author to perform more mastoidectomies on patients heretofore reluctant to submit to the postaural approach.

It is estimated that a quarter of a million civilians and soldiers in Britain are partially incapacitated by chronic otitis media. The reasons are briefly set out for regarding infancy as offering the best scope for preventive measures.

It is sometimes overlooked that in health the eustachian tube carries not only air to the ear but also fluid from this organ.

Conservative endaural operations are discussed. An operation with access via the cavum conchae is described and illustrated. Some 250 cases are briefly reviewed; success seems to depend mainly on the morbid anatomy of the temporal bone, although healing is a complicated process. Two cases are described; in one of these miniature earlids were provided by a simple plastic procedure.

A note on the earlids of alligators concluded the contribution. JOHN F. DELPH, M.D.

NOSE AND SINUSES

Butler, D. B., and Ivy, A. C.: Effects of Nasal Inhalers on Erectile Tissues of the Nose: Quantitative Studies. *Arch. Otolar.*, Chic., 1943, 38: 309.

The introduction of the nasal inhaler into the field of rhinological therapy has met with widespread acceptance by both the physician and the public. Many types of inhalers are now commercially available. Some contain powerful vasoconstrictor drugs such as amphetamine, while others contain old remedies such as menthol, camphor, and oil of eucalyptus.

Eleven normal individuals were subjected to quantitative studies in a series of 266 experiments. Studies of the changes in nasal resistance following the administration of various drugs revealed certain points of clinical importance concerned with these drugs. Quantitative experiments gave a comparative basis for analysis of the rationale of rhinological therapeutics and pointed the way to improvements in methods of administration of drugs for nasal medication.

In the method employed by the authors, several characteristics of the effects of the drugs can be studied. It is possible to determine latency of onset of action, intensity of effect, duration of effect, intensity of after-effect, and duration of after-effect. In the present experiments it seemed advisable to the authors to confine their conclusions to the first three of these characteristics of drug action.

Maximum relief of nasal obstruction occurred within fifteen minutes after the administration of the vasoconstrictors. This latency of maximum effectiveness seemed the same for all formulas studied. This can be explained probably by the fact that a certain time lag is required for the drugs to penetrate the mucous blanket of the nasal mucosa and reach the vascular bed, and a second time lag occurs before the musculature of the blood vessels contracts completely.

The undesirable effects of menthol in a pure form and of menthol-inhaler vapors are demonstrated by the fact that nasal obstruction is increased. Menthol, if used alone, gives the subjective impression of a reduction in nasal obstruction, because of the fact that the drug is an effective topical anesthetic which paralyzes many of the sensory nerve endings in the nasal mucosa. It also stimulates the sensory endings for cold in the nasal mucosa. Thus, inhaled air feels cool and the subject associates cool air with increased air flow through a clear nose, and has the impression of reduced nasal congestion.

The pronounced congestion following use of the menthol type of inhaler was shown to be much greater than that due to menthol alone. This is probably due to the presence of several other aromatic ingredients in such an inhaler, which also act as nasal irritants.

All of the present studies were conducted on normal subjects who had no inflammation or irritation of the nasal mucosa. NOAH D. FABRICANT, M.D.

Welsh, T. F.: Trans-Septal Sphenoid Approach with Implantation of Radium to Pituitary Fossa as Treatment for Adenomatous Tumors of the Pituitary Gland. *Laryngoscope*, 1943, 53: 724.

According to the best authorities the treatment of adenoma of the pituitary gland is both surgical and nonsurgical.

It is the author's belief that one who is familiar with the use of nasal illumination and instrumentation can remove as much of a tumor in the pituitary fossa as can be removed by a more complicated transfrontal route. Briefly, the technique consists of exposing the sphenoid after removal of the nasal septum and the sinus mucosa, and removing the presenting tumor with biting forceps. A capsule containing 50 mgm. of radium is then implanted in the remaining tumor mass.

In no case was there infection or undue postoperative sequelae. In all cases there was almost an immediate improvement in vision, which generally was maintained.

One thousand milligram hours seem to be the maximum safety dose for radium.

The author reports on a series of 5 cases.

JOHN F. DELPH, M.D.

MOUTH

Straith, C. LeR., and Patton, H. S.: Bilateral Congenital Mucous Cysts in Three Generations: Occurrence with Harelip and Cleft Palate. *J. Am. M. Ass.*, 1943, 123: 693.

In a family of thirteen there were in three generations six persons with bilateral harelips. Some of these patients had an associated cleft palate, but of more interest was the fact that each had a pair of hypertrophied mucous glands on the lower lip. These glands secreted a tenacious mucous material from two very prominent excretory ducts which

Fig. 1. Five members have had bilateral harelip, cleft palate, and mucous glands. The insets show evidence of these deformities in the first and second generations.

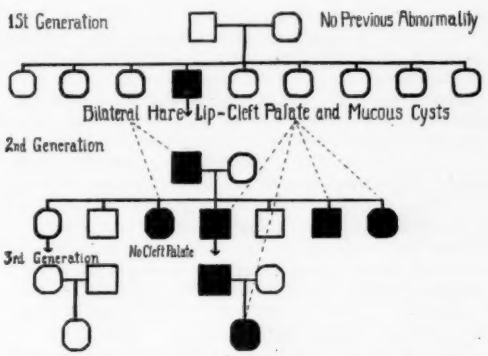


Fig. 2. An example of bilateral harelip and mucous glands in the third generation of this family.

opened just above the mucocutaneous line in the center of the lip. The authors were unable to explain satisfactorily the symmetrical occurrence of the two glands when many other such glands were in the vicinity. The occurrence must have followed mendelian laws in these cases and the glands must have had some analogue other than the numerous small mucous cysts found in this region. Excision is the treatment of choice.

LOUIS T. BYARS, M.D.

NECK

Jackson, C., and Jackson, C. L.: Trauma of the Larynx. *Arch. Otolar.*, Chic., 1943, 38: 413.

Injury to the larynx is not uncommon in cases of trauma to the neck.

Occlusion of the airway and asphyxia may occur at the time of injury from displacement of tissue, a short time later from submucosal hemorrhage or hematoma, an hour or more later from submucosal emphysema, with or without mediastinal emphysema, or hemorrhage into the trachea may be large enough to drown the patient.

Inflammatory reaction may cause asphyxia later from edema of the glottic tissues.

Bronchial obstruction is a common complication due to the retention of thick tenacious secretion and mediastinal emphysema. It commonly is interpreted as pneumonia but is relieved by bronchoscopic aspiration.

Mediastinal emphysema is common and may develop by two mechanisms. Subcutaneous cervical emphysema may occur and extend between the tissue layers into the mediastinum, or in the presence of a large open neck wound air may be sucked into the thorax and its escape prevented by valvular action. The patient may die of asphyxia, or of pressure effects on the heart, circulation, and innervation.

Laryngeal stenosis and total atresia are common complications, but are preventable. Total atresia is a calamity because of the loss of voice and the seri-

ous surgical problem involved in its relief. As long as any sort of lumen is present total atresia can be avoided with an endless braided silk thread worn in the larynx.

Early treatment includes general medical and surgical care. Morphine should be limited because of its depression of the respiratory center. Tracheotomy is indicated in practically every case of trauma to the larynx and should be deferred only if the patient is under constant observation and an operator is available. It is essential when indrawing is present and is also indicated in case of hemorrhage and cervical or mediastinal emphysema, to facilitate aspiration and the removal of foreign material or clot. It should always be done low, a few uncut tracheal rings being left above.

Simple fracture of the laryngeal cartilages without fragmentation usually calls for immediate insertion of a core mold as an internal splint. The mold should not be tight and the size may be increased as swelling subsides. In crushing injuries it is important to use core molds early.

In the presence of a virulent infection or of trauma to the interior of the larynx, the first core mold is not inserted until the infection is controlled or the necrotic tissue has sloughed off.

Débridement should be conservative since muscle and any cartilage attached to viable perichondrium may be valuable for building a support later.

If cicatricial stenosis has occurred, the mold must fit firmly and larger sizes must be substituted as the lumen is dilated.

In some cases the duration of treatment may be shortened by the use of Negus skin grafts.

When the pharynx or the esophagus is involved a soft rubber catheter is inserted through the nose and pharynx into the lower esophagus. This maintains a lumen during healing and permits proper feeding without soiling of the wound.

Core molds are made of natural hard rubber, ground to shape.

In the treatment of endolaryngeal burns, thick tenacious secretion should be aspirated from the tracheobronchial tree and mild sodium bicarbonate solution should be used as a spray. If this cannot be done through the bronchoscope a tracheotomy should be made to facilitate treatment.

JOHN R. LINDSAY, M.D.

SURGERY OF THE NERVOUS SYSTEM

PERIPHERAL NERVES

Spillane, J. D.: Localized Neuritis of the Shoulder Girdle: A Report of 46 Cases in the MEF. *Lancet*, Lond., 1943, 245: 532.

In the present war a hitherto unusual neuritis localized about the shoulder girdle has been noted in an increasing number of cases. This condition is not associated with any of the known etiological agents such as diphtheria, acute febrile polyneuritis, or polyneuritis associated with dysentery, malaria, enteric fever, or other disorders.

Burnard and Fox reported a similar group of 9 cases seen in the New Zealand Medical Corps of the Middle East. Richardson described 9 cases in one hospital in the United Kingdom, and Wyburn and Mason, 42 cases seen at the National Hospital.

The author reports a total of 46 cases. In one group of 26 cases the condition developed while the patients were hospitalized for other illnesses. Although some of these patients had dysentery, malaria, enteric fever, typhus, and cerebrospinal fever, they were all afebrile and convalescing. In a second group of 20 cases the neuritis occurred while the soldiers were on duty in the field.

Clinically, the cases were characterized by severe pain in various regions about the shoulder. There were no associated systemic reactions of any kind. Within a few days weakness was noted, followed in most cases by marked atrophy. The following muscles were affected: the serratus magnus, in 34 patients; the spinati, in 24; the deltoid, in 17; the trapezius, in 11; and the sternomastoid in 1 patient.

Sensory cutaneous alterations were found only in those cases in which the deltoid was affected, and in 10 such cases the sensory loss was found in the area of distribution of the circumflex nerve.

Although spinal punctures were done in 13 cases (7 during the acute stage), the cell counts were normal, and in only 1 patient was a very slight elevation in protein noted. The white-cell counts in 9 cases were normal.

Only in the mild cases was slow improvement noted; several patients showed no improvement after a period of from seven to eight months. However, a follow-up of these cases was difficult.

Since other muscles supplied by the same segmental region (cervical 5, 6, and 7) were always spared, and quite frequently only a single muscle was involved, it was deducted that this condition might be a peripheral neuritis of unknown etiology.

JACK I. WOOLF, M.D.

Michael, P., and Abbott, W.: The Use of Human Fibrinogen in Reconstructive Surgery. *J. Am. M. Ass.*, 1943, 123: 279.

This case report presents the use of human fibrinogen as a covering for a denuded sciatic nerve resulting from a high explosive fragment. The fibrinogen film was removed six weeks later, at which time healthy nerve tissue and excellent healing was observed.

A microscopic examination showed the "glossy amorphous structure" of the fibrinogen. No absorption of the film had occurred. "The nerve sheath showed some clearcut fibrinogen on the surface with a few round cells and fibroblasts in the sheath but very few neutrophilic polymorphonuclear cells or other indications of irritation." Thus there was no evidence of foreign-body or inflammatory reaction.

JACK I. WOOLF, M.D.

BRAIN AND ITS COVERINGS; CRANIAL NERVES

Magee, C. G.: Spontaneous Subarachnoid Hemorrhage: A Review of 150 Cases. *Lancet*, Lond., 1943, 245: 497.

One hundred and fifty cases of spontaneous subarachnoid hemorrhage from certain peculiar material were reviewed; some of the patients were applicants for pensions and others were in the Armed Forces. The age incidence of this group ranged from somewhat under twenty to over fifty. A special attempt was made to find out the mode of onset of the hemorrhage and whether trauma or exertion played a conspicious part in producing the rupture of the vessels. Two or 3 patients had had minor trauma, like having a football strike the head, and 1 or 2 were carrying heavy objects at the time, but the conclusion was reached that trauma and exertion were not a factor in producing rupture in this series; as a matter of fact, in almost one-third of them the rupture occurred while the patient was resting in bed.

The vast majority of cases occurred in the third and fourth decade. It was found that in the age group from twenty-one to thirty, recurrence followed in about 33 per cent and death in 48 per cent, whereas in the thirty-one to forty age group there was recurrence in 37 per cent and death in 66 per cent. Good recovery was very rare in the forty-one to fifty age group, although recovery was not very satisfactory in any of the others. In the whole series of cases the mortality rate was 56 per cent. With regard to the prognosis of the complaint, unconsciousness was the only factor which seemed to be present in cases with a bad outlook. Of the 84 fatal cases, 58 were brought to autopsy, and in 43 ruptured aneurysms were found. Of the 43 aneurysms 27 were in the anterior part of the circle, 9 in the posterior part, and 7 were unspecified. Incidentally, aneurysm occurred on the right side twice as often as on the left.

With regard to recurrences, the majority took place in the second and third weeks. An attempt was made to see if higher blood-pressure readings were a factor in rupture of the aneurysm, and 52

of the 63 cases in which there were records of blood-pressure readings showed a blood pressure of 150 mm. of mercury or under. The study is of interest, especially with regard to recurrence and prognosis.

ADRIEN VERBRUGGHEN, M.D.

Fleming, J. A. C., Hill, I. G. W., and Walmsley, R.: A Case of Intracranial Aerocele with Extension to the Lateral Cerebral Ventricle. *J. R. Army M. Corps*, 1943, 81: 101.

A case of intracranial aerocele or pneumocele following fracture of the skull by a land-mine explosion is reported. About three months after injury, the patient, who was considered almost ready to return to duty, began to complain of debility, headache, and loss of sense of taste and smell. He became disoriented and developed fever. Lumbar puncture yielded a turbid, xanthochromic fluid under slightly increased pressure containing numerous polymorphonuclear cells. Cultures of the fluid were sterile. Roentgenograms showed fractures of the frontal bone, a small aerocele behind the frontal sinuses, and air in at least one lateral ventricle and in the third ventricle. The patient died about one week after the onset of pyrexia. Post-mortem examination revealed traumatic lesions in the cribriform plate of the ethmoid bone, deficiencies in the overlying dura mater, and a pathological connection between these deficiencies and the anterior horn of the left lateral ventricle. Thus a direct communication between the external nares and the ventricular cavity was demonstrated in this case.

JOHN L. LINDQUIST, M.D.

Reid, W. L.: Cerebral Edema. *Austral. N. Zealand J. Surg.*, 1943, 13: 11.

Cerebral edema may be local or generalized. Local edema gives rise to focal signs, whereas generalized edema may give rise to the following signs: headache, drowsiness, vomiting, diplopia, convulsions, and elevated spinal-fluid pressure. The symptoms begin several hours after the trauma or other cause, and usually disappear when the causative lesion is removed. Intravenous hypertonic solutions usually hasten recovery.

The most common causes of cerebral edema may be classified as traumatic, inflammatory, and toxic.

Trauma to the brain may be caused by a blow to the head, brain operations, electrical stimulation of the brain, and by pressure exerted on the surrounding brain tissue by an expanding lesion. No cerebral edema is found in those cases in which death occurs instantaneously following a head injury. In those cases in which death does not occur the diagnosis of cerebral edema is presumptive. The following points are useful in recognizing the presence of edema; (1) a latent period of several hours between the trauma and onset of symptoms, (2) increased intracranial pressure, increased production of spinal fluid and absence of blood in the fluid, and (3) rapid amelioration following the intravenous administration of hypertonic sucrose.

Operative trauma may be produced by too forceful retraction of the brain or too violent pressure or traction during the removal of an intracerebral expanding lesion. Cerebral edema, hemorrhage, or thrombosis may occur. Signs due to edema occur from six to twenty-four hours after operation, and are focal in nature. The general condition of the patient is not greatly affected. The patient recovers spontaneously in a few days if left untreated. Cerebral edema responds to hypertonic solutions given intravenously. Postoperative hemorrhage is more rapid in onset and progressive if not relieved. There is little or no improvement with hypertonic solutions. Thrombosis is slow in onset, but does not respond to hypertonic solutions. Spontaneous recovery may occur, but it takes place over a period of weeks.

In cases of meningitis, edema exists throughout the brain. In abscess the edema is usually confined to the neighborhood of the abscess while it is small, but becomes more generalized as the abscess increases in size.

Toxic edema occurs in certain intoxications, particularly from lead, or it may occur with some form of extracranial sepsis, such as aural, dental, sinus, or respiratory. When the edema occurs with middle-ear sepsis, it is called otitic hydrocephalus. The patients with this condition usually recover. The main points on which the diagnosis of cerebral edema of toxic origin is made are: (1) a recent or concurrent history or discovery of sepsis or intoxication; (2) a fairly rapid onset of headache, which in severe cases may be accompanied by nausea, vomiting, drowsiness, papilledema, and absence of localizing signs; (3) increased cerebrospinal-fluid pressure; (4) ventricular puncture (when a brain needle is inserted in the lateral ventricles there is a sudden spurt of fluid and then the flow stops suddenly. This is usually indicative of small ventricles, the walls of which collapse onto the point of the needle as soon as the pressure is released); and (5) ventriculography, which shows the ventricles normal in mild cases, and compressed to mere slits, but not displaced, in severe cases.

On examination in cases of cerebral edema, the gyri are flattened and the sulci narrowed. There is less fluid in the subarachnoid spaces than usual, and the cut surface of the brain is moist and has a glazed appearance. The oligodendroglia always show various degrees of swelling. The perineural and perivascular spaces are widened and in severe cases the lining cells of the choroid plexus are slightly swollen with somewhat eccentric nuclei. No changes occur in the axis cylinders, myelin sheaths, astrocytes, microglia, ependymal cells, connective tissue, or meninges. The nerve cells occasionally show signs of mild swelling, but this is inconstant.

In the vicinity of intracerebral expanding lesions almost all the cerebral elements are affected. The nerve cells and the axis cylinders show only slight evidence of destruction. The oligodendroglia and the myelin sheaths become greatly swollen, even-

tually rupture, and are removed by phagocytes. The astrocytes undergo clasmatodendrosis, produce "gemaestete Zellen," and fibrous astrocytes with numerous fibers forming a barrier between the lesion and the brain. The microglia are converted into compound granular corpuscles. The blood vessels are increased in number and in certain cases there is a proliferation of their endothelial walls. The perineural and perivascular spaces are usually distended and the latter are often filled with compound granular corpuscles. Connective-tissue strands extend out from the blood vessels, and frequently they are quite dense. The choroid plexus, ependyma, and meninges usually show no change unless they are directly involved in the pathological process. The changes observed around expanding intracerebral lesions are obviously due to something more than the cerebral edema.

Treatment of cerebral edema consists of: (1) removal of the primary lesion without any special attention to the edema, which is sufficient in the majority of cases; (2) in severe cases, reduction of the intracranial pressure by lumbar drainage of the cerebrospinal fluid, intravenous administration of 25 or 50 per cent sucrose, and intramuscular administration of from ½ to 2 cc. of "salgyran" every two or three days. DAVID IMPASTATO, M.D.

Pilcher, C., and Meacham, W. F.: The Chemotherapy of Intracranial Infections: The Treatment of Experimental Staphylococcic Meningitis with Intrathecal Administration of Penicillin. *J. Am. M. Ass.*, 1943, 123: 330.

This report is concerned with the effects of penicillin administration in experimental staphylococcic meningitis. The disease was produced by injecting a saline suspension of virulent hemolytic staphylococcus-aureus organisms into the cisterna magna. The duration of life and the mortality rate were used as criteria in the statistical evaluation of results.

Intravenous administration of penicillin was followed by no significant beneficial effect in staphylococcic meningitis, which confirmed the observations of others that penicillin does not pass through the blood-brain barrier in significant quantities. Intrathecal administration of penicillin, on the other hand, prolonged life or lowered the mortality rate in every one of 4 series of experiments. In 47 experiments only 6 per cent of the control animals recovered, whereas 46 per cent of the treated animals recovered. Recovery was more frequent in animals receiving treatment after the injection of staphylococci than in those receiving treatment before the injections. Cerebrospinal fluid cultures remained positive for several or many days even in the animals that recovered. No harmful effects attributable to penicillin were observed.

JOHN L. LINDQUIST, M.D.

Pilcher, C.: Meningioma. *Ann. Surg.*, 1943, 118: 909.

The meningioma reported in this article is believed by the author to be the largest intracranial neoplasm ever reported. The patient was a white male, aged twenty-five, who had had symptoms for fifteen months, which for the most part were referable to the posterior fossa. At operation a huge mass was found lying on the superior surface of the tentorium. The tumor was successfully removed and recovery of the patient was uneventful.

Pathological examination of the tumor showed it to be nearly spherical, with a diameter of 12 cm. and a weight of 374 gm. The capsule was smooth, thick, and intact, except at the area of excavation which had included the dural attachment. Microscopically the tumor tissue was typical of meningioma of a fibroblastic type. JOHN L. LINDQUIST, M.D.

SYMPATHETIC NERVES

Ray, B. S., Hinsey, J. C., and Geohegan, W. A.: Observations on the Distribution of the Sympathetic Nerves to the Pupil and Upper Extremity as Determined by Stimulation of the Anterior Roots in Man. *Ann. Surg.*, 1943, 118: 647.

The sympathetic nervous supply of the upper extremity has been a matter of considerable interest to neurological surgeons for many years because of the fact that incomplete sympathectomy of these extremities has led to recurrence of the symptoms for which the operation was performed. It is well known that recurrence in Raynaud's disease is partly due to incomplete sympathectomy in the upper extremity, whereas in the lower extremity recurrence is rare with a more complete sympathectomy. The difficulty in the case of the upper extremity has been to determine the exact outflow from the spinal cord. This outflow was estimated on the basis of changes in skin resistance. It is well known now that the skin resistance is lowered with sympathetic activity and raised following the abolition of sympathetic impulses.

The skin resistance was tested in 18 cases in which the lower cervical and upper thoracic regions of the spinal cord were exposed at operation. In these cases the anterior nerve roots were electrically stimulated, and observations were made on changes in the pupils and on diminished skin resistance in the hands. The method is explained in some detail and a table of the results is appended. Incidentally, it was found that in patients with Raynaud's disease, divisions of all but one of the anterior roots, found to possess preganglionic fibers to the hand, resulted in the preservation of sympathetic effects.

In 16 patients in whom the study was made, principally directed toward the hand, it was found that there was a variation in the upper and lower levels of the sympathetic outflow within the limits of the first thoracic and tenth thoracic segments. However, in the majority of cases the outflow was from the second, fourth, and fifth thoracic segments. With regard to changes in the pupils, it was discovered that in the 10 patients examined, the sympathetic innervation travelled throughout one or more roots

between the levels of the eighth cervical and fourth thoracic segments. The majority here appeared to pass out from the first and second thoracic segments.

ADRIEN VERBRUGGHEN, M.D.

Burdenko, N. N.: The Effect of Frostbite on the Sympathetic Nervous System. *Am. Rev. Soviet Med.*, 1943, 1: 15.

The vascular reflexes associated with frostbite and methods of restoring them to normal equilibrium are considered in this study. Basic problems concern the mechanism and nerve components of these reflexes, as well as the possibility of interrupting the reflex arcs at their most accessible points. The reflex phenomena observed during chilling and frostbite are a general reaction of the sympathetic nervous system with adrenalinemia and local reflexes in the exposed part. The local receptor fibers may be stimulated by (a) temperature, (b) pain, and (c) reflexes originating in the veins, as from increased venous pressure. All of these elements increase vasomotor tone, and changes are most violent at the moment when the initial transient spasm of the vessels occurs. This phase is followed by vasodilatation and a secondary spasm. The reactions are reversible and the problem involves removing or relieving the spasm through interference with components of the reflex arc. Complete physiological interruption of the nerve fibers concerned cannot be achieved because of anatomic factors.

In blocking the efferent and afferent fibers there are three possibilities: (1) blocking the efferent nerve fibers close to the arterial trunk in the extremity; (2) blocking the lumbar region by perfusing the spinal ganglia and aortic plexus; and (3) blocking the afferent nerve fibers by paravertebral and parasacral anesthesia. All three methods were studied by means of kymograms, capillaroscopies, and roentgenograms of the capillaries, to evaluate the effect on vasoconstrictor tone.

Local anesthesia applied in the area of main blood vessels, such as the subclavian or femoral arteries, was hardly effective. This was to be expected since the vasoconstrictors within the arterial walls arise at varying levels from the somatic nerves. Local anesthesia designed to block the vascular nerve led to similar results. The latter method should be more effective since it blocks not only the efferent but also the afferent fibers. It is a difficult method to use and has some inherent dangers, since it requires multiple injections into a chilled extremity in which stasis is present.

Attention is called to the fact that when the lower extremities are chilled the vessels contract as far as the common iliac artery. Tests showed that effective blocking is achieved by attacking the afferent nerve fibers, particularly the posterior roots. Positive results were obtained in 80 per cent of the cases.

During the war with Finland the author found that paravertebral anesthesia in the lumbar region presented no technical difficulties and did not require large quantities of anesthetic solution. Injections could be repeated daily if necessary. The upper extremities may be anesthetized, although the process is difficult, by injecting from 40 to 50 cc. of 0.5 per cent novocaine into the area of the neck, as in vagosympathetic blocking, or into the cervical plexus by the Kulenkampf method. These procedures are necessary because of the anatomic peculiarity of the subclavian and brachial artery innervation. Favorable results were obtained with the solution, recommended by Hoffman and Kochmann, containing potassium sulfate and adrenalin, although the addition of adrenalin is not considered very desirable.

JOHN L. LINDQUIST, M.D.

Reeves, T. K., and Lipman, G. S.: A Review of Superior Hypogastric Sympathectomies over a Period of Ten Years. *Pennsylvania M. J.*, 1943, 46: 1274.

The superior hypogastric plexus has its origin in the aortic plexuses between the superior and inferior mesenteric arteries—usually at the level of the inferior mesenteric artery. The fibers of the plexus divide into two bundles, one running along the inferior mesenteric artery, and the other continuing straight down on the anterior wall of the lower part of the aorta to the bifurcation, whence it crosses the left common iliac vein, rises over the promontory of the sacrum, and continues downward into the pelvis (as the hypogastric nerves) where it terminates in the hypogastric ganglia. The length varies between 6 and 8 cm.

The hypogastric plexus produces vasoconstriction of the blood vessels of the internal genital organs and inhibits the secretion of the genital glands. The parasympathetic nerves produce the opposite effect. Section of the plexus does not alter the menstrual cycle, does not interfere with uterine contractions during labor, nor does it produce glandular atrophy or any disturbance in the motor functions.

In the superior hypogastric sympathectomy the abdomen is opened infraumbilically, incision of the posterior parietal peritoneum being made at the level of the sacral promontory and continued upward to the level of the inferior mesenteric artery and downward to the third sacral vertebra. The postganglionic fibers from the inferior mesenteric artery are dissected downward to approximately 2½ cm. below the sacral promontory and excised. In cases of urinary vesical disturbances the dissection is extended 2½ cm. on the hypogastric nerves. Care must be taken in all cases to extend the dissection laterally so that the anastomosing fibers of the parasympathetic nerves are interrupted. The cut ends of the plexus are left untied.

The operation is recommended by the authors for carcinoma of the uterus and bladder, dysmenorrhea, and idiopathic disturbances of the bladder. They report on 41 follow-up cases. Thirty of the patients were completely relieved of menstrual pain, 8 had mild cramps, and 3 had no relief.

DAVID IMPASTATO, M.D.

SURGERY OF THE THORAX

CHEST WALL AND BREAST

Cory, A. S.: Wound Healing after Thoracoplasty in a Tropical Hospital. *J. Thorac. Surg.*, 1943, 12: 653.

A study was made of wound healing after various stages of thoracoplasty for pulmonary tuberculosis in a sanitorium in the British West Indies. Two series of 90 operations each were compared, the operative technique being essentially the same, but in the second series 5 gm. of sterile powdered sulfathiazole were scattered over the wounds before closure.

The first six ribs were removed in stages; a mixture of silk and catgut was used for suture; drainage was seldom employed (no drainage with sulfathiazole); and the periostea of the ribs were generally formalinized.

In the presulfathiazole cases only 69 per cent of the wounds healed by primary intention, whereas after sulfathiazole was introduced, 93 per cent of the cases healed perfectly.

Before the use of sulfathiazole 17 per cent of the wounds were superficially infected and required the removal of one or more stitches; deeper infection developed in an additional 5 per cent, among which, 3 cases presented disorganization of the wound and 1 of these later became a tuberculous infection. There were no superficial infections in the wounds in which sulfathiazole was used; a localized deep infection occurred in a patient who had developed gross sepsis during an earlier operation before the use of sulfathiazole. No toxic effect of the drug was observed.

ERNEST E. ARNHEIM, M.D.

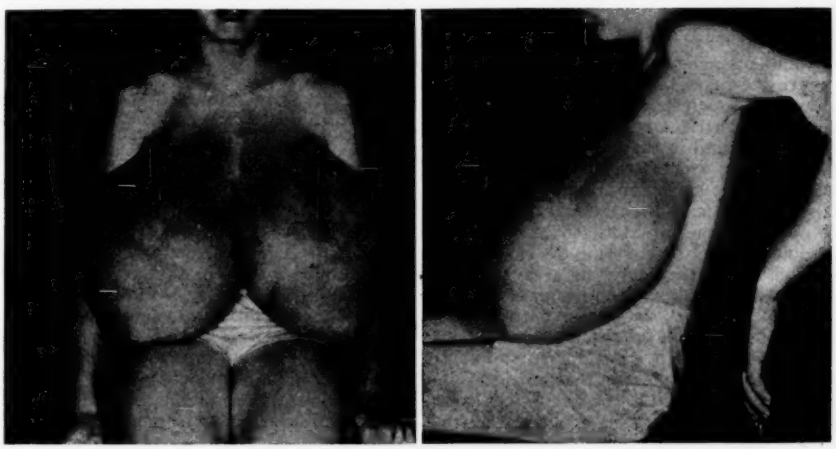
Fisher, G. A., Schauffler, G. C., Gurney, C. E., and Bendshadler, G. H.: Massive Breast Hypertrophy. A Notable Case. *West. J. Surg.*, 1943, 51: 349.

The authors describe the case of an eleven-year-old girl in whom, within a period of seven months, the breasts began and completed a development to a total weight of 35 lb. (each breast weighed 17½ lb.).

The inadequate literature concerning this condition and the lack of knowledge concerning its etiology are discussed. The author was able to find only 31 other cases of massive pubertal breast hypertrophy in the literature.

Notable factors in this case are (1) the alarming speed with which the condition developed; (2) the conspicuous failure of endocrine therapy; (3) the complete absence of irregularity in the development of other sex characters, or, in fact, in any other normal growth; and (4) the necessity for, and the success of, complete surgical removal of both breasts.

The following substances were tried: chorionic gonadotropic hormone (antuitrin S), estrogen (estreesol), thyroid extract, and synopoidin (a combination gonadotrope), but the rate of breast hypertrophy was unaffected by any of them. The breasts were then removed singly, three weeks elapsing between the operations.



Figs. 1 and 2. Front and side views of the patient immediately prior to operation, seven months after beginning hypertrophy. Note in Figure 1 (left) pressure on hands to maintain upright posture. In Figure 2 tension on forearms to maintain breast weight and hold shoulders erect. Reclining on back, the patient's respiration was seriously embarrassed. Reclining on side, comfortable disposal of the breasts was virtually impossible.

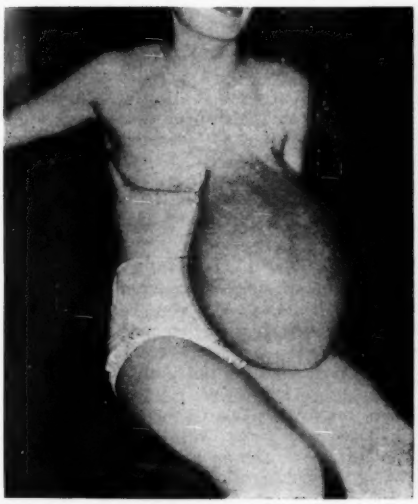


Fig. 3. The patient after the first operation.

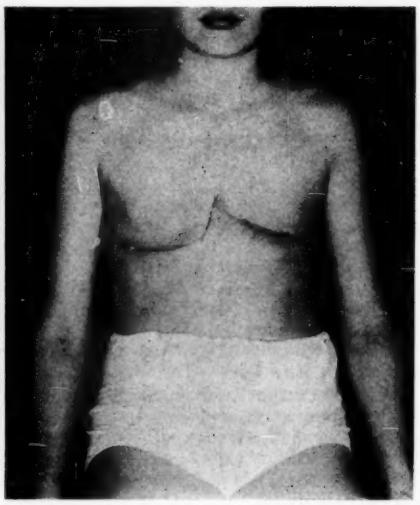


Fig. 4. The patient twenty-three days after second operation. Note comparative relaxation of shoulder girdle and absence of muscle tension.

The pathologist's diagnosis was diffuse adenofibrosis with hyaline degeneration and marked hypertrophy. DANIEL G. MORTON, M.D.

Wu, Y. K., and Pianetto, M. B.: The Problem of Wound Infection in Thoracoplasty. *J. Thorac. Surg.*, 1943, 12: 648.

Wound infection is a serious complication in thoracoplasty for pulmonary tuberculosis which markedly increases the mortality rate even with early proper treatment. The authors have developed a new surgical routine which reduces the incidence of infection from 11.8 per cent to practically nothing in a large series of cases.

Several measures were taken to avoid contamination of the skin. Particular emphasis is placed on thorough cleansing and in the use of pads under the sterile towels placed around the incision to absorb promptly the blood and perspiration of the patient.

The danger of air contamination may be reduced either by radiating the air in the operating room with ultraviolet light or by covering the wound with towels in such a way that only the area necessary during the stages of the operation is exposed to the air. At the end of the operation the entire wound surface is irrigated with a large amount of warm normal saline solution to remove not only tissue debris and blood clots but also bacteria that have been deposited from the air. Injury to the soft tissues is also reduced to a minimum with care and not too hurried operation. The smallest possible size of suture material is used. Drainage of the wound is not considered necessary.

A pressure dressing is applied at the end of the operation to reduce tissue edema and to maintain good immobilization. Dressings are changed when necessary and if a hematoma is found in the wound, the blood is removed by aspiration. A blood transfusion of 500 cc. is given routinely at the end of each operation for replacement of the lost blood and to promote wound healing. Particular care is also given to such conditions as anemia, hypoproteinemia, and hypovitaminosis, which predispose to delay in wound healing and may lower the resistance of the patient to infection.

CONRAD PIRANI, M.D.

TRACHEA, LUNGS, AND PLEURA

Lloyd, M. S., and Budetti, J. A.: Bronchoscopy in Pulmonary Tuberculosis. *J. Thorac. Surg.*, 1943, 12: 668.

The authors' study based upon the objective findings in 475 bronchoscopies shows that tuberculosis in the parenchyma of the lung is always accompanied by changes in the mucous membrane of the draining bronchus. These changes are of the same nature as the pulmonary lesion and vary with the progress of that lesion. They may be studied bronchoscopically in the visible airways. Therefore, this method of examining the lung serves as a most important guide to the management of collapse therapy.

An attempt is made by the authors to classify tuberculous lesions of the bronchi so that they and their significance may be more easily recognized. To this end, color drawings of the various lesions, together with the reports of the cases from which they are taken, are included.

Bronchoscopy emphasizes, from a new angle, the dangers inherent in artificial pneumothorax. It

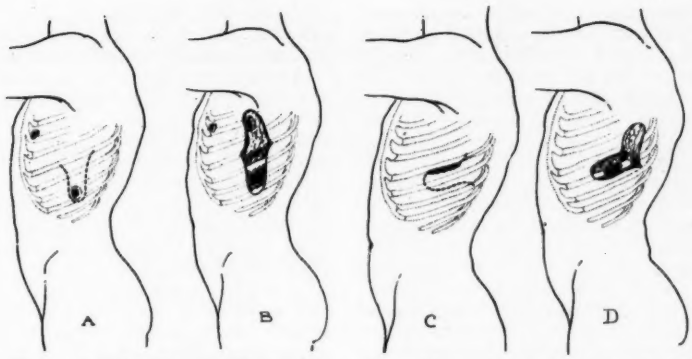


Fig. 1. A and B diagrams illustrating usual site of flap and approximate length of rib removed. C and D variation in direction and site of flap as might be indicated where an old thoracotomy scar may be used as one border of flap.

demonstrates clearly the necessity of interfering as little as possible with the drainage and ventilation of the uninvolved lobes and lung. It provides additional support to the belief that every pneumothorax should be a selective pneumothorax and that a contraselective pneumothorax may be actually harmful. At the same time, it provides an additional means of knowing when pneumothorax has failed and when it should be discontinued, changed in its mode of application, or replaced by another method. JOSEPH K. NARAT, M.D.

Brown, A. L.: Simple Drainage of Intrathoracic Suppurations. Use of an Endocutaneous (Eloesser) Flap. *Am. J. Surg.*, 1943, 62: 169.

The use of the endocutaneous (Eloesser) flap for drainage of intrathoracic suppurations in 54 patients form the basis of this report.

The procedure described by Eloesser in 1936 was devised for the drainage of infected tuberculous empyemas when little postoperative care following drainage would be available. The flap provided for drainage with also some check-valve action. This developed some negative pressure within the empyema space which was thought to aid its obliteration.

The operative technique is carried out under local anesthesia, and the flap, as illustrated, is placed parallel with the line of the ribs. A full thickness skin flap is fashioned to measure approximately 12 by 6 cm., and any previously existing scar or sinus is excised. The pleura underlying is removed in sufficient amounts so that the tip of the flap is well within the cavity and the opening is adequate for drainage after the flap is in place.

The types of cases reported were as follows: mixed tuberculous empyema, 17; tuberculous empyema, 6; tuberculous cavity requiring drainage, 12; and nontuberculous empyema, 16. There was 1 case each of silicosis with empyema, cystic disease, and ecchinococcus cyst.

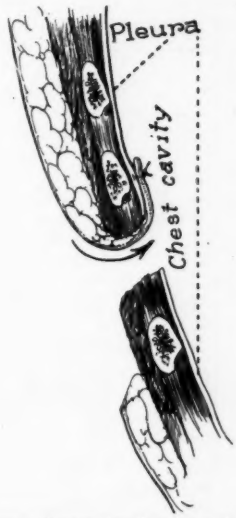


Fig. 2. Diagram illustrating fixation suture which holds the flap in contact with the parietal pleura. It is to be noted that the subcutaneous tissue and fat have been gradually tapered off the distal end of the flap. (Courtesy of American Journal of Surgery.)

Of the 54 patients, 46 were, and 8 were not, benefited. The advantage of this method for draining intrathoracic suppurations is that it is especially applicable in wartime when postoperative care is more difficult. WILLIAM E. ADAMS, M.D.

HEART AND PERICARDIUM

Zerbini, E. de J.: Coronary Ligation in Wounds of the Heart. *J. Thorac. Surg.*, 1943, 12: 642.

Approximately 600 cases of wounds of the heart are reported. Ligation of a branch of a coronary

artery in the treatment of a myocardial wound is not an infrequent occurrence but the reported cases are rare. In this article a case of ligation of the anterior descending branch of the left coronary artery with complete return to normal is described.

A six-year-old boy had been injured by an iron splinter which had penetrated the fourth intercostal space to the left of the sternum. The patient was comatose with imperceptible pulse and blood pressure. There was marked cyanosis and high venous pressure. Surgical intervention was decided upon and after resection of a portion of the fourth left rib the pericardial opening was enlarged and the blood and clots were removed which revealed a laceration of the right ventricle extending to the anterior descending branches of the left coronary vessels at a point about 4 cm. from the apex. The laceration was closed with interrupted sutures of silk and the injured coronary branches were ligated. During the postoperative period a large amount of fluid formed in the pericardial sac (traumatic pericarditis). The patient was treated with absolute rest in bed for two months and repeated aspirations of fluid from the pericardial cavity.

The postoperative series of electrocardiograms failed to reveal the typical pattern of myocardial infarction. The electrocardiographic changes must have been related to the pericarditis as they disappeared after its treatment.

About one year after the accident the patient shows no diminution of cardiac reserve nor heart pain. The electrocardiogram shows no sign of myocardial infarction and there are no abnormalities in lead 4 as reported by Olim and Hughes in a similar case observed in 1939. CONRAD L. PIRANI, M.D.

MISCELLANEOUS

Birnbaum, G. L., and Thompson, S. A.: Pulmonary and Blood Gas Studies in Experimental Asphyxia and Asphyxial (Anoxia) Resuscitation. *J. Thorac. Surg.*, 1943, 12: 607.

Prompt institution of resuscitation procedures and their inherent effectiveness are two important factors in the success or failure of resuscitation. Circulation and respiration go hand in hand. They are interdependent. Resuscitation procedures, consequently, should consider an adequate supply of oxygen to the lung as well as an adequate circulation to carry oxygen, as quickly and efficiently as possible, to the heart muscle and brain.

To determine the efficacy of various methods of resuscitation, obstruction asphyxia and inhalation asphyxia with nitrogen were investigated experimentally. At various stages of asphyxia, pulmonary and blood gas studies were made.

A comparison of methods of resuscitation revealed that manual artificial respiration with oxygen inhalation was the least effective of the methods tested, while rhythmic inflation and suction with oxygen was by far the most effective. The latter method, moreover, could be used at a much longer period after cessation of respiration.

The methods tested were manual artificial respiration, rhythmic inflation, rhythmic suction, and rhythmic inflation and suction. It was shown that resuscitation is largely a reflex mechanism from the lung in which the vagus and carotid sinus are concerned. It is, probably, partly the superior and regular ventilatory excursion of the lung which accounts for superiority of one method over another. It requires more than reflex impulses to keep the heart, muscles, and the centers of the brain alive without oxygen.

From the pulmonary and blood gas studies made at various stages of asphyxia, the hypothesis was drawn that in asphyxia the anaerobic conversion of glycogen to lactic acid may supply limited energy for the heart and brain. This, together with the marked reflex stimulation it affords, could explain the effectiveness of asphyxial resuscitation in advanced asphyxia.

It was found, moreover, that in both obstructive and nitrogen inhalation asphyxia, there is first a rise and then a fall of the total carbon-dioxide content of the blood.

Early in asphyxia and for a short time after the respiration has ceased, oxygen without carbon dioxide would appear indicated. The fall of carbon dioxide is interpreted as representing an acidosis with an associated acarbia, or carbon-dioxide deprivation. The acidosis itself might be stimulating to the cerebral centers and carotid body when present in conjunction with the administration of oxygen only.

Whether the administration of carbon dioxide in addition to the administration of oxygen is actually detrimental would be difficult to say. The use of from 5 to 7 per cent carbon dioxide with oxygen would, however, seem advisable in order to prevent and treat acarbia and to stimulate the cerebral centers.

The impression that the inert gas method should be preferred is not intended by the authors; each form of artificial respiration resuscitation has its field of usefulness, and should be used when indicated. STEPHEN A. ZIEMAN, M.D.

SURGERY OF THE ABDOMEN

GASTROINTESTINAL TRACT

Pappworth, M. H., and Loutit, J. F.: Gastroduodenal Hemorrhage Treated Medically with Enthusiastic Blood Transfusion. *Lancet*, Lond., 1943, 245: 469.

Figures for the mortality from gastroduodenal hemorrhage vary enormously. When results of medical treatment have not been satisfactory, surgery has been advocated although it is not generally desirable.

In a series of cases (most of them severe) treated medically, satisfactory results were obtained by complete rest, morphine when necessary, a modified Witts' diet, kaolin mixture, and vitamin C, along with additional massive and practically continuous blood transfusions.

Accurate classification of hematemesis is impossible. Multiple hemorrhages may be called severe, and single hemorrhages may also be regarded as severe if signs of secondary shock are present. If either of these conditions were found to be present, 500 cc. of whole blood were given at a moderately rapid rate every half hour until there were clinical signs of improvement, paralleled by a rise in the systolic blood pressure to 100 mm., or restoration of a normal pulse pressure. The transfusion was then slowed to a drip rate of from 40 to 60 drops a minute. Cases with a hemoglobin of 60 per cent (Haldane) and without shock symptoms were transfused at a drip rate throughout, with the use of whole blood or concentrated red-cell suspension.

Thirty cases (16 men and 14 women) were thus treated. These cases fell into 4 clinical groups: (1) single hemorrhage without shock, 11 cases; (2) single hemorrhage with shock, 2 cases; (3) multiple hemorrhages in young persons of less than forty-five years, 8 cases; and (4) multiple hemorrhages in elderly persons with or without hyperpiesia, 9 cases.

There was but 1 death, which occurred in the last group.

It is believed that blood transfusion, correctly applied, is the most important single factor in the saving of life in cases of severe gastrointestinal hemorrhages. The amount of the transfusion should be controlled by repeated blood-volume estimations; if this is not possible, a systolic blood pressure of less than 90 mm., a pulse rate greater than 140, a blood urea greater than 100 mgm. per 100 cc., and hemoglobin of 40 per cent, or less, should be the controlling factors.

It was shown that the drip rate of transfusion did not tend to make the hemorrhage recur, and exclusion of pyrogens from the transfusion fluid eliminated dangerous pyrexial reactions. With repeated bleedings, the transfusion should be repeated as often as the bleedings recur or as often as is necessary to keep the hemoglobin greater than 60 per cent. For the slow, persistent bleeder it appeared safe to give from 1½ to 2 liters per day at a drip rate.

It has been universally accepted that the treatment of mild hemorrhage, especially in young patients, is medical; however, that of severe hemorrhage is debatable, the authors contending that surgery appears to be indicated only in special clinics or when there is additional indication such as obstruction or perforation. STEPHEN A. ZIEMAN, M.D.

Heuer, G. J., and Holman, C.: The Effect on Gastric Acidity of Gastroenterostomy and Gastric Resection for Peptic Ulcer. *Ann. Surg.*, 1943, 118: 551.

Surgical procedures which destroy or diminish acid gastric secretion have been carried out with the hope of curing peptic ulcer and preventing its recurrence. Twelve hundred patients with peptic ulcers were studied by the authors over a period of ten years. For this report, only those in whom careful pre- and postoperative acidity determinations had been made were included. The acid determinations were made by means of the histamine method of Bloomfield and Polland.

The authors' studies were undertaken primarily to determine the effects of gastroenterostomy and gastric resection upon acid secretion, and in the group under observation there were 75 patients upon whom gastroenterostomy had been performed. Ninety-two per cent of these showed free hydrochloric acid equal to, and in the large majority of cases greater than, normal (60° free HCl). The average postoperative acidity for the 75 patients was 82° free HCl. Among 50 of these patients, 56 per cent showed a slightly higher preoperative than postoperative acidity. In only 10 per cent of the cases was there significant diminution of the acidity following operation. Satisfactory results following gastroenterostomy were found in 75 per cent of the patients who had been followed up for periods of from six to ten years, with postoperative acidities varying between 0° and 132° free HCl; unsatisfactory results were found in 25 per cent of the patients, with acidities varying between 50° and 130° free HCl.

The results of this study would suggest that gastroenterostomy affects the acid secretion of the stomach in exceptional cases only, and that satisfactory or unsatisfactory results are not related to the secretory activity of the stomach.

Eighty-eight patients with gastric and duodenal ulcers were subjected to gastric resection. Of these, 63 had duodenal ulcers and 25 had gastric ulcers. Of 31 patients in whom minimal gastric resection was done, 26 per cent had a low acidity postoperatively while 74 per cent had an adequate or high acidity. Satisfactory results were obtained in 90 per cent of the patients. Of 46 patients subjected to moderate

resection, 80 per cent had low acidity postoperatively while 20 per cent had an adequate or high acidity. Eighty-nine per cent of this group presented satisfactory results. Of 11 patients subjected to major resection, 91 per cent had a low postoperative acidity, while 9 per cent had an adequate acidity. All of these 11 patients presented satisfactory results. The results in these groups would suggest that gastric resection reduces acid gastric secretion, and in direct proportion to the extent of the resection. The results were 10 per cent better in the patients with low postoperative acidity than in those with adequate or high postoperative acidity.

These studies also bring out the fact that the satisfactory results from gastric resection do not parallel the gastric acidity. Among the patients who had a minimal resection, only 25 per cent had an acidity below normal, although the results were as good as those obtained in patients subjected to a moderate resection, following which 80 per cent had an acidity below normal, and of the patients who underwent a major resection, 90 per cent had a low acidity. Subtotal gastric resection, of whatever magnitude, does not ensure an achlorhydria, and the beneficial effects of gastric resection are not necessarily due to the reduction of acid secretion. The chances of ensuring an achlorhydria or better results by increasing the magnitude of the resection beyond a moderate one are rather small.

Of 163 patients with peptic ulcer who had been subjected to gastroenterostomy or gastric resection, 37 per cent had a low acidity while 63 per cent had an adequate or high acidity. In this group as a whole, the results were satisfactory in 83 per cent of the patients. The authors believe that a reduction in acid secretion is not the sole factor in achieving the results obtained in these two types of operation. Following gastroenterostomy, there was no significant change in the acid secretion.

In a group of 75 patients, satisfactory results were obtained in 75 per cent. After gastric resection there was a reduction in acid secretion in proportion to the extent of the resection. In the group of patients who had minimal resection, the results were satisfactory in 90 per cent of the patients, but there was a reduction in acid in only 25 per cent.

The author suggests that operations for the treatment of ulcer should be of lesser magnitude to ensure fairly satisfactory results and a reasonable mortality.

RICHARD J. BENNETT, JR., M.D.

Yarnis, H., and Colp, R.: Lymphosarcoma of the Stomach. *Gastroenterology*, 1943, 1: 1022.

The authors review 8 cases of lymphosarcoma of the stomach and present a brief summary of the case histories and pathological findings.

Seven of the lesions were typical of small round-cell lymphosarcoma; one was a reticulum-cell sarcoma.

The diagnosis is seldom made clinically. Grossly, the lesion may be diffusely infiltrating, appearing as simple hypertrophy of the rugae, or there may be a definite tumor. Gastric resection is the procedure of choice for the latter type. In the former type of lesion the stomach may appear and feel normal at operation. If, in this type of case, x-ray or gastroscopic findings have led to the suspicion of malignancy gastrotomy should be done and a section of the stomach removed for histological study. In some cases excellent results have followed roentgen therapy of this type of lesion. On the whole, however, the results of the treatment of this lesion were poor.

EDWARD W. GIBBS, M.D.

Sweet, R. H.: Total Gastrectomy by the Transthoracic Approach. *Ann. Surg.*, 1943, 118: 816.

The technical advantages of the transthoracic approach for resection of carcinoma of the stomach or of the lower esophagus with involvement of the cardia have been well established. However, experiences with total gastrectomy by this method have been disappointing and the mortality has been high. The chief difficulty has seemed to be leakage from the suture line of the esophagojejunal anastomosis, probably the result of undue tension on the suture line caused by the jejunum being pulled up to such a high level.

The fundamental principles of gastrointestinal surgery, namely, the avoidance of tension on the suture line and adequate preservation of the blood supply, must be observed in this as in all types of anastomoses. The absence of a serosal layer in the esophagus necessitates an accurate and individual apposition of mucosal and muscular layers.

In a few patients the proximal jejunal loop can be brought up to a level adequate to permit anastomosis without undue tension on the suture line, but in the majority of cases the mesentery of this loop is too short.

The author's operative technique to avoid tension on the esophagojejunostomy suture line in a case in which the two organs cannot be brought together by ordinary means is as follows:

After removal of the stomach and closure of the duodenal stump, the highest jejunal loop is drawn through an opening in the transverse mesocolon. In the majority of cases it can be pulled up no further than 1 or 2 cm. above the level of the diaphragm because of shortness of the mesenteric vessels in this area. If, at this point, the main artery which supplies the proximal jejunal loop is identified carefully and cut between ligatures close to its origin from the superior mesenteric artery, and if the vein is treated similarly, the pull of the mesentery on the loop is greatly relaxed. Its apex may then be advanced as much as 3 in. into the chest above the level of the diaphragm. This permits the anastomosis to be completed without undue tension. Great care must be taken to avoid damage to the collateral vascular arches.

It is important for the loop of jejunum to be pulled up in such a manner that the afferent arm is short enough to avoid sagging and resultant puddling in the proximal loop and duodenum.

After the anastomoses are completed, the jejunal loop must be anchored to the mediastinal pleura and to the cut edge of the diaphragm as it is approximated about the loop.

The operation of total gastrectomy followed by esophagojejunal anastomosis has been performed seven times at the Massachusetts General Hospital, Boston. Two patients died postoperatively of sepsis. The 5 remaining patients recovered promptly without major complications. The case records of each of these 7 patients are reported in detail.

EDWARD W. GIBBS, M.D.

LIVER, GALL BLADDER, PANCREAS, AND SPLEEN

Schwyzer, A.: White Bile. *Minnesota M.*, 1943, 26: 955.

In a series of 1,064 operations on the biliary passages, the author encountered so-called "white bile" in 9 cases, exclusive of hydrops of the gall bladder. Every one of these cases was later excluded, since this fluid proved to be pancreatic secretion. After a discussion of various theories as to the formation of "white bile," and mention of experimental work that had been reported, the following probable explanation of its production is advanced.

As the obstruction of the external biliary-duct system gradually occurs, the pressure in the ducts increases and the liver secretion becomes poorer in the essential ingredients. As the biliary secretory pressure is quite low, the flow of bile ceases when this secretory pressure level is exceeded. The ducts with their higher secretory force continue to secrete their colorless fluid. With this increased pressure the contents of the bile ducts can still be forced through the obstructed area, and thus the contents of the ducts are gradually thinned out and become paler and paler until complete stoppage takes place. If the obstruction is complete from the onset, absorption at the periphery of the liver lobules will have the same effect as gradual dilution, and finally the bile is replaced by colorless secretion from the ducts. The two modes of exit may be found in some cases. Infection is believed not to be a basic cause of surgical white bile.

Normally colored bile may start flowing immediately after decompression, and recovery may follow. If normal bile does not appear in from thirty-six to forty-eight hours after the obstruction has been released, the prognosis is very grave.

EARL O. LATIMER, M.D.

Brunschwig, A., and Templeton, F. E.: Roentgenographic Diagnosis of Neoplasms of the Periampullary Region and Head of the Pancreas. *Radiology*, 1943, 41: 438.

The feasibility of radical excision of carcinoma of the ampulla of Vater and of the head of the pancreas, together with the entire duodenum, should stimulate increased interest in the roentgenographic diagnosis of neoplasms in these regions. Several cases of this kind which were operated on are cited briefly and illustrated to correlate the pathological with the roentgenological findings.

A neoplasm arising within the ampulla expands the latter, which gives the appearance of a smooth enlarged papilla of Vater. Theoretically this should be easily demonstrable, but inability to produce marked distention of the duodenum with barium probably accounts for frequent failure of detection at fluoroscopy. Ampullar carcinomas may also afford flattened ulcerations with raised rolled edges. These may produce consistent irregularities in the outline of the duodenal wall accentuated by a stiffness of the involved segment. Extensive infiltration of the duodenal wall by ampullar carcinoma, or carcinoma primary in the second portion of the duodenum, causes great distortion of the wall and rigidity of the involved segment, and should be easily detected. In these cases, also, normal mucosal markings are replaced by irregular coarse markings and polypoid masses may protrude into the lumen.

Frostberg's "reversed 3" (Ɛ) sign, when present, is of great significance, but its absence does not signify that a neoplasm can be ruled out. It may be simulated by prominent folds in the duodenum seen in profile but in a true "reverse 3 sign," the "lips" are broader and, furthermore, constancy in the location of the deformity in the presence of peristalsis and palpation is the important feature.

All of the criteria for ampullar carcinoma may be present and yet no neoplasm be found. This fact is illustrated by a case which is described, in which the operation revealed a cirrhotic liver, and an abnormal protuberance downward from the right lobe was found to be the structure palpated before operation and thought to be the gall bladder.

Small carcinomas in the head of the pancreas usually do not produce duodenal distention and should not be expected to yield roentgenographic signs of their presence. If they arise in the periphery, they may invade the duodenal wall and produce areas of rigidity or actual ulceration which may be accompanied by stenosis and obstruction of the duodenum. A large carcinoma replacing the head of the pancreas may show a minimum of distortion in the duodenum or may produce no alteration in the duodenal contour. Marked widening of the duodenal curve, when present, ordinarily indicates an advanced neoplasm of the head of the pancreas.

Although roentgenographic examinations may afford clear-cut evidence of the presence of ampullar carcinoma or carcinoma of the head of the pancreas, the absence of such findings should not postpone an exploratory operation in the presence of suggestive clinical manifestations. Nor should exploration be refused because of roentgen evidence of extensive duodenal involvement, since resection of even large tumors in this region may afford some degree of palliation for those patients whose average length of life in the absence of treatment is but from six to eight months after the onset of symptoms.

A. HARTUNG, M.D.

Fig. 1. Showing omentum, stomach, transverse colon, and small bowel eviscerated.

Fig. 2. The patient four weeks after closure of the abdomen. (Courtesy of American Journal of Surgery.)

MISCELLANEOUS

Wikle, H. T., Lutz, M., and Ryan, R. J.: Massive Traumatic Evisceration. Case Report. *Am. J. Surg.*, 1943, 62: 282.

A review of the literature reveals few cases of massive abdominal evisceration in which the patients recovered.

This is a case report of a nine-year-old Puerto Rican boy who was struck in the abdomen by a ragged automobile fender which caused an extensive transverse laceration of the right upper abdomen with evisceration of the omentum, stomach, transverse colon, and small intestine.

The eviscerated organs were covered with compresses moistened with normal saline solution, and the usual intensive therapy brought the boy out of shock with the aid of intravenous administration of saline solution, plasma, adrenaline, coramine, and caffeine.

One and a half hours after admission, the boy's blood pressure was 140/86 and his pulse 120, and operation was done under open drop ether. The skin edges were débrided and the protruding viscera were cleared of all gross dirt and clothing; the latter were then irrigated with copious amounts of normal saline solution and 1,000 cc. of an 0.8 per cent solution of sulfanilamide.

There was no gross bleeding. The intestines and stomach were replaced and the lacerated liver was repaired by 3 mattress sutures; 6 gm. of equal parts of sulfanilamide and of sulfathiazole were placed in the peritoneal cavity and the wound. The abdominal wall was closed with through-and-through figure-of-eight chromic No. 2 catgut sutures. The abdomen was not drained. The patient received 3,000 units of tetanus antitoxin and 1 ampoule of gas-gangrene antiserum. Beginning the next day ½ gm. of sulfathiazole was given orally every four hours. The postoperative course was stormy. The patient's condition improved and the wound was healed completely on the 46th day. The patient was discharged on the 81st day.

JOSEPH GASTER, M.D.

GYNECOLOGY

UTERUS

Miller, N. F.: A Consideration of Certain Factors Pertaining to the Control of Carcinoma of the Cervix. *Am. J. Obst.*, 1943, 46: 625.

The author's clinic carefully evaluated and treated nearly 2,000 carcinomas of the female generative tract. Of this number, 65.8 per cent, or 1,235, were cancers of the cervix. The limitations of existing methods of treatment are well recognized. No one expects the impossible, but there is good reason to believe that therapy is disappointing. Both irradiation therapy and surgery are potent weapons. Perhaps neither has been developed to its fullest efficiency.

To justify universal acceptance, a clinical grouping of cancer of the cervix should be simple, practical, easily understood, clearly defined, based on actual physical findings and not on assumptions; it should be one that places emphasis on early cervical cancers, and not on the advanced lesions for which existing remedial measures prove so disappointing.

As an example of a clinical grouping which fulfills the requirements listed, the author presents the following:

Clinical Group I. Very early carcinoma of the cervix. In general this group includes the early, suspicious, often unrecognizable clinically but histologically proved carcinomas of the cervix, i.e., intraepithelial lesions and carcinoma arising in a cervical polyp.

Clinical Group II. Any clinically recognizable histologically proved carcinoma still confined entirely to the cervix. No parametrial thickening.

Clinical Group III. Carcinoma of the cervix with questionable parametrial thickening. The cervical lesion may or may not be extensive, the characteristic feature of this group being the question concerning parametrial involvement. Into this group are placed those patients concerning whom there might well be a difference of opinion regarding the involvement of adjacent tissues.

Clinical Group IV. All advanced carcinomas of the cervix. Those with definite parametrial thickening, vaginal infiltration, frozen pelvis. (May be subdivided for statistical purposes.)

Survival rates and cure rates are not synonymous. In 66 per cent of the cases of cancer of the cervix, death was the result of uremia, and/or impaired renal function caused by encroachment of the neoplasm or scar tissue upon the ureters. As a means of prolonging life, the possibility of ureterointestinal anastomosis and ureterostomy may well deserve comprehensive study and trial. Lay education to the point of developing a symptom consciousness has long been considered the best approach to the problem of cancer control.

EDWARD L. CORNELL, M.D.

MISCELLANEOUS

Hufford, A. R.: The Synthetic Estrogen Octofollin (in Oil). *J. Am. M. Ass.*, 1943, 123: 259.

Twenty-one patients in the female climacteric were treated with intramuscular injections of octofollin in oil. The criteria for effective treatment were two: subjective relief and response of the vaginal smear. However, the evaluation of the activity of estrogens in human therapy by the vaginal-smear technique is not a precise laboratory procedure.

Octofollin is a new synthetic estrogen and is not a derivative of stilbestrol. The results following the use of octofollin are compared with those of diethylstilbestrol and it is believed that octofollin is much less toxic and produces far fewer side reactions than diethylstilbestrol. The statement is made that "not one of the twenty-one (21) patients reported any untoward reaction of any kind during the course of therapy." Whether or not they had untoward reactions is not stated, but at least they were not reported.

The most common dose used was 5 mgm., but a few patients were given only 2 mgm. at a time, and the most common interval between doses was one week. Some patients were given 2 injections a week for a while and then the injections were given at weekly and even monthly intervals. The author states that in his opinion octofollin provides prolonged beneficial effects, which means adequate comfort to the menopausal patient with fewer injections than of other estrogenic substances.

He also states that undesirable side reactions encountered frequently in therapy with diethylstilbestrol, such as headache, nausea, vomiting, dizziness, soreness of the breasts, pelvic pain, and excessive or frequent uterine bleeding, did not occur.

The results given here in this very small number of patients would indicate that this new synthetic estrogen, when administered parenterally in oil to menopausal patients, is an effective estrogen and is nontoxic in therapeutic doses.

CHARLES E. GALLOWAY, M.D.

Roberts, R. K., Loeffel, E., and MacBryde, C. M.: Octofollin, a New Synthetic Estrogen. *J. Am. M. Ass.*, 1943, 123: 261.

Sixty persons having estrogen deficiency were treated with octofollin, and 44 case studies are analyzed in the report by these authors. The attendance of the remaining patients at the clinic was too irregular for the reports to be included. The work was carried out at Washington University School of Medicine, St. Louis, Missouri.

The report covers the use of octofollin in the treatment of estrogenic deficiencies and the authors compare this new synthetic estrogenic substance with diethylstilbestrol. The most common clinical objec-

tions to diethylstilbestrol have been nausea and uterine bleeding. Various series of cases show that from 10 to 60 per cent of the patients complain of nausea, and some patients will not tolerate even the smallest dose of this substance.

This new synthetic estrogen 2–4-di (parahydroxyphenyl)-3-ethyl hexane, later named octofollin, was first studied and reported on by Blanchard (*Endocrinology*, 1942, 30: 1026).

From their studies, the authors have come to the conclusion that octofollin is best administered by mouth. It may be given continuously, or its administration may be interrupted. The effective oral dose is from 5 to 10 mgm. daily, or in cases in which the treatment is interrupted, from 10 to 15 mgm. may be used daily.

The results are reported from the standpoint of subjective effects and objective effects. Subjectively, from 5 to 10 mgm. of octofollin daily are required to relieve hot flushes and other menopausal symptoms satisfactorily. The authors observed very few untoward reactions. Three women complained of some mild abdominal discomfort, and 5 had an increase in the white seromucoid vaginal discharge, but nausea did not occur in any of the 44 women treated, even with doses as large as from 10 to 20 mgm. every twenty-four hours.

Objective effects were studied by employing vaginal smears as a simple means of measuring estrogenic activity. However, it was discovered that the administration of this estrogenic substance did not produce any significant change in the vaginal smear in a large percentage of patients who reported relief of their subjective symptoms. It was almost impossible to correlate subjective relief with objective results based upon vaginal smears. Uterine bleeding was produced in 3 of the 18 women who had undergone interrupted treatment.

The dosage of octofollin was determined by means of hepatic function tests, and blood and urine studies. The use of octofollin did not produce any demonstrable change in the function of the liver, and no abnormality was noted in the number of erythrocytes or leucocytes. Repeated examinations of the urine of 38 patients showed no change that could be attributed to the medication.

Some animal experiments also were performed with octofollin. One experiment was done to determine the effect of octofollin on the bone marrow of dogs, and it was believed that the number of thrombocytes and leucocytes in 1 of the 2 dogs used for this purpose had been definitely reduced, but at autopsy no significant change from normal was noted in the bone marrow of the other animal. From their observations these authors concluded that both diethylstilbestrol and estradiol are much more potent than octofollin.

It would appear that octofollin is a relatively nontoxic synthetic estrogen, that it is quite effective in the treatment of hypogonadal symptoms in women, and that the effective dose is from 5 to 10 mgm. daily when continuous treatment is used, and from 10 to 15 mgm. daily when interrupted treatment is given. CHARLES E. GALLOWAY, M.D.

Talisman, M. R.: A Clinical and Laboratory Study of the Synthetic Estrogenic Substance, Octofollin. *Am. J. Obst.*, 1943, 46: 534.

A detailed study of the clinical effectiveness and possible toxicity of a new synthetic estrogen, octofollin (which is unrelated to the stilbenes), was made. It has proved to be an effective estrogen when administered either orally or parenterally, and much less toxic than diethylstilbestrol at the therapeutic levels. In the intensive study of the hospitalized and the clinic group, the average therapeutic range for oral therapy is from 1 to 5 mgm. per day. In those patients who, for various reasons, do not respond well to oral therapy, complete or marked relief may be obtained after intramuscular administration of the drug in oil: 2 to 5 mgm., one to three times per week.

Twenty-one carefully selected patients, from whom all ovarian tissue was removed, were given large overdoses of octofollin for varying times beginning on the fourth postoperative day, and a careful study was made of possible abnormal changes occurring in the blood cell picture, hemoglobin level, blood pressure, urine, and icteric index which might indicate toxic reactions to the drug. Sixteen of these patients have been followed up in the gynecological endocrine clinic after their release from the hospital—the earliest cases for six months. No evidence of any toxic changes was found. A single case of nausea and vomiting in this postoperative group was stopped by reducing the dose to half—20 mgm. per day to 10 mgm. per day. The resultant dose was still above the necessary level, and later elevation of the dosage did not bring about a recurrence of the complaints. E. L. CORNELL, M.D.

OBSTETRICS

PREGNANCY AND ITS COMPLICATIONS

Braze, A.: Bicornate Uterus with Pregnancy in Each Horn. *J. Am. M. Ass.*, 1943, 123: 474.

The few reports of gestation in a bicornate uterus which have been recorded indicate that it is unusual for such gestations to continue uneventfully to term. The following complications are quite frequently encountered:

1. Weak pains associated with atony in the third stage may occur with resultant post-partum hemorrhage.

2. Dystocia may be produced by prolapse of the nonpregnant horn under the other with incarceration in the pelvis, or by the downward pressure on the nonpregnant cervix which forces it downward to the vulva with the head. A review of the literature has revealed a definite lack of adequate reports on pregnancies in each horn of a bilateral uterus.

In 1925 Rowlett of Florida described a case of a double uterus with a pregnancy in each horn. The patient went into labor after five months of gestation and miscarried 2 male fetuses weighing 3 pounds 4 ounces (1,420 gm.) and 2 pounds 3 ounces (990 gm.).

In 1934 Barrett of the Vanderbilt University Hospital in Tennessee reported a bicornate uterus with a pregnancy in each horn. Both infants were born prematurely and died shortly after delivery.

In 1939 Johnston, of Akron, Ohio, reported a case with a dead fetus in one cornu and a normal pregnancy in the other.

According to the author, the case presented represents the only recorded case in the literature of pregnancy in each horn of a bicornate uterus which proceeded uneventfully to term with consequent delivery of two normal viable children.

The patient was a twenty-four-year-old white woman who was first seen by the author in active labor. One year previously she had had a delivery in the home; the membranes had ruptured spontaneously prior to the onset of labor, which continued with severe dystocia and resulted in the delivery of a female child which lived for only a few hours.

Examination revealed an extremely broad abdomen containing two sets of fetal heart tones, 140 per minute on the right and 135 on the left. Both fetal heads were palpable and the diagnosis of twins was readily made. There appeared to be a depression between the two fetuses, a fact which aroused the suspicion of the presence of a bicornate uterus. Inspection of the introitus revealed a third-degree cystocele and rectocele. According to the roentgenologist's report, a flat posteroanterior film of the abdomen showed the presence of twins. The two fetal heads were floating above the pelvic inlet. Both heads were presenting, one on each side of the pelvis. Both of the fetal heads appeared to be attempting to enter the pelvis. There was evidence of pressure on both heads, which is not unusual during labor, but the pressure on one of the heads appeared to be due to the other head pushing against it.

At 10 a.m. there occurred a relatively simple spontaneous delivery of a viable 5 lb. 12½ oz. (2,620 gm.) boy. The placenta was delivered intact at 10:12 a.m. from the right horn, but despite firm contraction of this horn, profuse hemorrhage continued. At 10:19 a.m. a living 6 lb., 9 oz. (2,869 gm.) girl was delivered by manual pressure over the left fundus and its placenta followed intact at 10:25 a.m.

The mother and twins were dismissed from the hospital in excellent physical condition in two weeks.

Approximately three months following her dismissal from the hospital, the patient was readmitted with severe cramping of the lower abdomen. A diagnosis was made of prolapse of the left horn of the uterus with incarceration of the pelvis.

At laparotomy the incarcerated fundus was relieved with some difficulty. The uterus then presented itself as two widely divergent horns, each with its own tube and ovary and with no visible site of fusion. The body of the uterus was then removed *in toto*, the process revealing the site of fusion to be just above the internal cervical os. The pathologist reported a diagnosis of uterus bicornis unicollis.

DANIEL G. MORTON, M.D.

Lund, C. J., and Kimble, M. S.: Vitamin A During Pregnancy, Labor, and the Puerperium. *Am. J. Obst.*, 1943, 46: 486.

Plasma vitamin A values during pregnancy reflect in general the dietary intake of the vitamin. As the pregnancy progresses the vitamin A values decrease, but the appearance of the decrease is delayed according to the adequacy of the diet. Storage of the vitamin plus increased demands of pregnancy probably account for the observed decrease in the blood values. Mobilization of the vitamin into the blood stream occurs within twenty-four hours post partum. Following the immediate puerperal mobilization of vitamin A, the values are usually well maintained during the remainder of the puerperium.

There was no correlation between plasma vitamin A and carotene values. The relationship between these two substances in the blood stream remains obscure. Complications of pregnancy and labor, and puerperal morbidity were less frequent when the plasma levels remained above 90 I.U. per cent; however, it is hazardous to attribute the responsibility of cause to a vitamin deficiency when many other factors are involved also.

Plasma vitamin A values were generally low in women who had not received prenatal care. The ingestion of an adequate diet according to accepted

standards provides enough vitamin A to maintain normal blood values during the first trimester. During the second trimester 5,000 I.U. of vitamin A daily are necessary in addition to an adequate diet. This amount should be increased to 10,000 I.U. during the last trimester. Needs during the puerperium can usually be supplied by a good diet alone unless lactation is unusually abundant and prolonged.

E. L. CORNELL, M.D.

NEWBORN

Henderson, J. L.: Infection in the Newborn. *Edinburgh, M. J.*, 1943, 50: 535.

The author discusses the problem of infection in the first month of life.

During the three-year period from 1940 to 1942, 8,075 infants passed through the Simpson Maternity Pavilion. Three hundred and eighty-two of these infants died in the hospital within a month of birth. The cause of death was determined in 369 of the cases. The incidence of the principal causes of death in this series is shown in the following table:

THE INCIDENCE OF THE PRINCIPAL CAUSES OF NEONATAL DEATH IN 369 INFANTS

Condition	No. of Cases	Incidence Per Cent
Asphyxia	106	28.8
Infection	81	22.0
Intracranial hemorrhage	57	15.4
Developmental malformations	51	13.8
Prematurity	46	12.5
Miscellaneous	28	7.5

More infants die in the first three days than in the whole remainder of the first month. The causes of this high initial mortality in order of frequency are asphyxia, intracranial hemorrhage, prematurity, and developmental malformations. Infections rarely cause death in the first three days. After the first week, the vast majority of deaths are caused by infection. Infants who survive the first few days should, with few exceptions, be safe if a high standard of care is provided. This is seldom attained in institutions caring for large numbers of infants, with the result that there is much preventable acquired disease in the neonatal period. Infections are much the most common and most dangerous of these acquired diseases. A drastic reduction in the incidence of preventable infections, notably epidemic gastroenteritis, is the most urgent problem confronting administrators and the staff of all large maternity hospitals at the present time.

There follows a discussion of the various types of infection encountered. Gastroenteritis, thrush, staphylococcal infections, and streptococcal infections are most common.

The degree of susceptibility to various organisms in the early weeks depends to a considerable extent on the degree of immunity possessed by the mother and the extent to which this has been passed on to the infant. Specific immunity is therefore passive in the early weeks, but a degree of active immunity to various organisms soon develops as a result of exposure to them after birth. The human fetus received its maternal antibodies via the placenta during pregnancy.

Local immunity also plays an important part in counteracting infection. The nutrition of expectant mothers is of great importance; the necessity for an optimum diet in pregnancy, though long appreciated, has been proved scientifically in recent years in a number of large-scale controlled experiments.

Optimum infant nutrition can be attained only by breast feeding from a mother on an adequate diet. Artificial feeding can never be a perfect substitute. The incidence of death from infection is known to be many times higher in artificially fed than in breast-fed babies.

All investigators are agreed on the fundamental causes of the high incidence of neonatal infection in maternity hospitals. These causes are:

1. Overcrowding of the infants in nurseries and the absence of barrier nursing precautions.
2. Inadequacy of the nursing staff.

The author advocates the accommodation of each mother and her baby either in a single room or in a small ward with cubicles or partitions. The baby would never leave the cubicle except for weighing and would have its own toilet requisites, bath, and thermometer. Each cubicle would have a wash-hand basin which would always be used by the doctor and nurse after attending to either the mother or the baby. Handwashing is most important after attending to every patient. The use of rubber gloves would also be advisable.

Nurses who are attending to infants should always report any personal illness before going on duty. Any infective condition such as a cold, sore throat, or skin infection contraindicates the nursing of infants, and some other duty should be allotted to the nurse if she is able to work. When the staff is inadequate these precautions fall down. At present, too small a proportion of the nurses are fully trained and sufficiently experienced. The pupil nurses are changed to new duties every few weeks for training reasons. Therefore, a considerable proportion of the nurses attending to the infants are completely inexperienced in infant care and hygiene.

DANIEL G. MORTON, M.D.

GENITOURINARY SURGERY

ADRENAL, KIDNEY, AND URETER

Braasch, W. F., and Strom, G. W.: Renal Trauma and Its Relation to Hypertension. *J. Urol.*, Balt., 1943, 50: 543.

A review of 50 cases with clinical evidence of renal trauma would indicate that although renal injury may be related to hypertension it is not a common cause. Nephrectomy was performed in 5 cases. Hypertension existed in 3 of these cases, and, following removal of the kidney, the blood pressure returned to normal. In the 2 other cases, the preoperative blood pressure was normal. The small number of patients with renal injury who underwent nephrectomy would corroborate the value of conservative treatment.

In 38 of 45 cases in which no operation was indicated, the blood pressure was found to be normal subsequent to renal injury. In 6 of the other cases, the degree of hypertension was moderate and the hypertension either existed prior to renal injury or was explained by factors other than renal. In only 1 of these cases was renal trauma considered a possible factor in the production of hypertension.

It is apparent that the resulting changes in the renal tissue following injury usually do not cause hypertension. In those cases in which operation was not indicated, it was evident that the injured renal tissues had healed or that moderate, mild, circumscribed cicatricial changes had resulted.

Hypertension due to renal trauma usually occurs in cases in which there is secondary renal infection. This is in keeping with the fact that changes in the renal tissues secondary to chronic infection have been noted in most renal lesions which are known to cause hypertension. There was one exception, however, in the case of a patient with hypertension who was observed nine months after injury, in whom an encapsulated hematoma was compressing a large portion of the kidney without infection.

When hypertension exists following renal injury it may be difficult to determine whether the injury is an etiological factor, unless the blood pressure and other clinical records prior to injury are available.

In several cases the clinical records made prior to renal injury showed that hypertension had existed previously. Without these data, an erroneous conclusion might easily have been made.

Bugbee, H. G.: Adenoma of the Kidney with Associated Lesions. Report of 3 Cases. *J. Urol.*, Balt., 1943, 50: 389.

Three cases of adenoma of the kidney are reported, and the literature is briefly summarized.

The first case was that of a forty-three-year-old male who had gradually increasing intermittent left flank pain and finally a persistent soreness in the same groin. Retrograde cystoscopy was unsatisfactory, but intravenous pyelography demonstrated a large indistinct left renal pelvis. A diagnosis of left hydronephrosis was made. At operation a kidney three times normal size was exposed and then removed. Examination revealed a hydronephrosis and adenoma. The stoma revealed numerous areas of hemorrhage and lymphoid infiltration.

In the second case a hypertensive female of fifty-seven years had suffered severe attacks of hematuria for three years. The right kidney was without function and the urine contained red cells and pus. The x-rays demonstrated 2 renal calculi. At operation the kidney was found to be a pyonephrotic sac with a yellowish tumor in the upper pole, which was microscopically diagnosed as an adenoma. The postoperative course was uneventful, except for a marked reduction in the hypertensive blood pressure. This patient lived in comfort for twelve years when she died of a coronary occlusion.

The third case was that of a fifty-seven-year-old male who was subjected to a nephrectomy because of a nonfunctional and enlarged right kidney. The kidney demonstrated marked enlargement and harbored a tumor mass. A pathological diagnosis of papillary adenoma of the right kidney with a tuberculous abscess of the lower pole was made. The progress of the patient was uneventful to date although the operation was performed early in 1938.

These renal adenomas arose in connection with hydronephrosis in one instance, with pyonephrosis in another, and in the third case in conjunction with tuberculosis. Adenomas arise most frequently in kidneys which are the seat of vascular disease in the later decades of life, and are the result of a proliferative reaction of the tubules due to impaired circulation from such causes as hydronephrosis, pyonephrosis, and chronic infection such as tuberculosis. This factor should be considered when ureteropelvic plastic surgery is anticipated. Large adenomas, when not producing hematuria, may account for pressure symptoms, and their removal offers a much more favorable prognosis than can be expected from removal of frankly malignant tumors of the kidney.

ROBERT LICH, JR., M.D.

Weisel, W., Dockerty, M. B., and Priestley, J. T.: Wilms' Tumor of the Kidney: A Clinicopathological Study of 44 Proved Cases. *J. Urol.*, Balt., 1943, 50: 399.

Forty-four cases of Wilms' tumor treated at the Mayo Clinic from 1904 to 1940, inclusive, are reviewed from the clinical and pathological standpoints. Wilms' tumor is a malignant mixed tumor of the kidney seen primarily in childhood, but it can occur at any age. The most prominent clinical feature is an abdominal mass, but fever, emaciation, and hematuria are common symptoms. The clinical course runs progressively and rapidly downhill.

The treatment of choice at present is prompt surgical extirpation combined in certain cases with preoperative irradiation and always followed by postoperative roentgen treatment. Prognosis is serious as the majority of patients fail to survive longer than one year. In the present series only 7 of 44 patients were living from two to twenty years after operation.

The pathological diagnosis of Wilms' tumor depends primarily on the finding of glandular and stromal cells in a more or less characteristic mixed tumor arrangement. Other types of tissue, notably striated muscle, are found in about half of the cases. The origin of Wilms' tumors is still obscure.

Deming, C. L.: Ureteropelvic Obstruction Due to Extrinsic and Intrinsic Lesions of the Ureter as a Clinical Entity and Its Treatment. *J. Urol., Balt.*, 1943, 50: 420.

The subject of ureteropelvic obstruction is discussed "as a clinical entity by deleting all unknown and doubtful factors"; that is, the author reported upon only those cases which presented definite demonstrable extrinsic and intrinsic factors of obstruction. Instances in which complicating or indistinct conditions were present in conjunction with the renal obstruction were not discussed.

The selected group comprised 82 individuals and of these, 35 were males. Sixteen patients presented a bilateral lesion; 29 of the remainder showed disease of the left kidney and 37 disease of the right kidney. The highest incidence of bilateral involvement occurred in the second decade of life, and infection was most evident in the later decades. A total of 35 kidneys were infected. In the first two decades males were affected more often than females, the ratio being 2 to 1; after the twentieth year females were affected more often. The left kidney was involved more often during the first two decades, but after the fifth decade both kidneys were equally involved. Thirty-two individuals presented ureteropelvic obstruction due to intrinsic lesions, and 50 presented obstruction due to extrinsic lesions (fibrous bands, 24; vessels 26). This statistical information is recorded in detail, and other interesting factors are presented in a table.

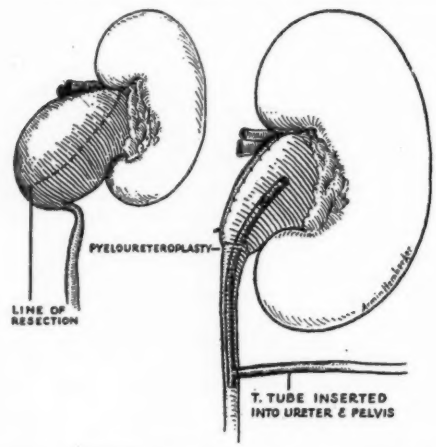


Fig. 1. Drainage of an infected hydronephrotic kidney after partial resection of the pelvis and reimplantation of the ureter.

The treatment of ureteropelvic obstruction must of necessity be directed toward relieving the obstruction; it should permit physiological emptying of the renal pelvis, preserve renal function, and conserve all aberrant vessels. Whether or not this can be accomplished by a single plastic procedure is dependent upon the specific case in question. The procedures used by the author to attain this goal are classified as: (1) nephrectomy; (2) plastic operation on the renal pelvis; (3) plastic operation on the ureter; (4) combined plastic procedures on the pelvis and ureter; and (5) nephropexy.

Nephrectomy is reserved for complete renal destruction, which is most common during the two extremes of the life span and is least common during adolescence. In the author's series, 40 cases were treated by this procedure. Twenty-seven patients were treated by various plastic procedures, and 15 of the 42 conserved kidneys were treated by nephropexy and lysis of the ureteropelvic obstruction. The patients in the latter group of cases were primarily of teen age. Many nephropexies were done in association with plastic procedures, which explains the high incidence of nephropexy. There were no operative deaths. All types of plastic procedures were used, and all but 2 of the patients were relieved and were found to have satisfactory kidney function.

In the management of uninfected kidneys, the use of drains and ureteral splints is condemned on the grounds that there is danger of the introduction of renal infection. However, in the presence of renal infection, drainage is considered essential. The author advocates the use of a No. 12 gall-bladder T-tube for drainage rather than nephrostomy. The accompanying drawing demonstrates this procedure.

ROBERT LICH, JR., M.D.

GENITAL ORGANS

Sewell, W. A. and Mailer, R.: Prostatic Enlargement Treated by the Braasch-Bumpus Punch. *Lancet*, Lond., 1943, 245: 479.

In a series of 101 patients submitted to perurethral resection, malignancy of the prostate was present in 10. In 13 patients suprapubic cystotomy was carried out as a preliminary measure because it was impossible to pass a rubber catheter, the indwelling catheter was not tolerated, or because drainage had to be prolonged beyond the usual ten-day period. In another group of 7 patients, permanent suprapubic drainage had been instituted at periods varying from three months to five years before admission.

The eldest patient in the series was eighty-seven years of age, and the average age of all patients was just over sixty-nine years. Seven deaths occurred in the entire series, 5 in the first 50 cases and only 2 in the second 50. This drop in mortality was due partly to increasing technical experience and partly to a realization that the method of treatment had its limitations and that the procedure could not be made safe for every patient.

The results were classified as good in 68 patients, fair in 15, and unsatisfactory in 11. The last group of patients included those who required subsequent enucleation because the punch treatment had failed to relieve the obstruction, those in whom frequency and bladder discomfort remained prominent, and those in whom there was nonmalignant enlargement with recurrence of symptoms within two years after operation. Only a few recurrences were observed after three and four years; in most of the cases relief was obtained for five years and more.

In the relatively younger patients with large prostates, suprapubic enucleation is still the operation of choice; however, the authors consider the perurethral procedure a great advance in the treatment of the older and frailer patients. In general hospital practice a large majority of the patients are in this latter group; the choice otherwise would lie between permanent suprapubic drainage and a hazardous removal by open operation.

The drop in mortality attributable to the introduction of the punch operation becomes especially significant when taken in conjunction with the rise in the operability rate over the same period. During the period from 1924 to 1933, only half of the patients admitted to the hospital with prostatic obstruction were considered fit for suprapubic enucleation and, as the high death rate shows, this estimate was too optimistic.

The mortality rate in the total series of 192 patients treated during the years from 1934 to 1941 shows that from two-thirds to three-quarters of the total number of patients admitted with prostatic obstruction have a good chance of permanent relief from their symptoms, and that many of them are saved from the gloomy prospect of permanent suprapubic drainage. Of administrative interest is the fact that the average stay of these patients in the hospital has been cut by more than one-half.

There remains a large body of prostatic sufferers, amounting to about a quarter of the total admissions, who are beyond surgical aid. Many die within forty-eight hours of admission. Perhaps in the future the knowledge that relief can be obtained by a relatively minor procedure will encourage such patients to come earlier for treatment.

The punch method is most useful in cases of fibrous prostate, in medium adenomatous enlargements, and in the palliative treatment of the malignant prostate. As general surgeons with restricted numbers of cases, the authors do not claim to have explored all the possibilities of the operation.

JOHN A. LOEF, M.D.

Prince, C. L., and Vest, S. A.: Carcinoma of the Prostate. *South. M. J.*, 1943, 36: 680.

A review of 189 consecutive cases of carcinoma of the prostate seen at the University of Virginia Hospital, university, Virginia, over the ten-year period from 1931 through 1940, forms the basis for the present report. Carcinoma of the prostate has been shown to be much more common than is generally realized. It occurs in from 17 to 20 per cent of all men over fifty years of age. The present figures show an actual as well as a relative increase in the number of prostatic carcinomas seen during the past decade.

Approximately 75 per cent of the patients in these cases were between the ages of sixty and eighty when first seen, which is in agreement with the figures of other observers. The average age on admission was sixty-nine and four-tenths years. The chief symptoms were frequency, difficulty of urination, nocturia, and, to a much less extent, dysuria. Hematuria was rarely noted. In 12 patients there were no urinary symptoms, and in 7 of these the symptoms were due to skeletal metastases. The average duration of the symptoms was two years.

The authors state that diagnosis based on palpation of the mass rectally is simple in the advanced cases. Suspicious nodules which lie chiefly in the posterior prostatic area are readily amenable to exposure perineally, and to biopsy.

It was found that the duration of life of 42 patients with skeletal metastases upon admission was only eleven and four-tenths months, and more than 75 per cent of these patients died within a year, regardless of treatment.

Therapeutic procedures varying from the use of the indwelling urethral catheter to radical perineal prostatectomy are listed under 13 categories. The authors used radon seeds or roentgen rays alone, as well as in conjunction with suprapubic and transurethral operations. One of every 6 patients, in the group of 189 studied, died in the hospital. The average duration of life of 125 patients who were seen more than three years ago, and upon whom follow-ups were obtained, was twenty-two and seven-tenths months.

In cases in which the growth has spread beyond the confines of the prostate, or in which metastases are present, the obstruction is best relieved by transurethral resection. In these cases castration may be very beneficial, and deep x-ray therapy may be useful in treating pain from bone metastases.

The authors believe that whenever a small, firm nodule of third-degree induration is discovered in the prostate, it should be considered as a carcinoma until this is disproved. The diagnosis in such cases is best made by perineal exposure of the gland and removal of a small portion of the suspected area for frozen section and immediate microscopic examination. If carcinoma is found, radical perineal prostatectomy may then be carried out.

Cure of the condition is possible only by radical perineal prostatectomy, and only through careful

routine rectal examination of all males past forty-five years of age can more cases suitable for cure be discovered. ARTHUR H. MILBERT, M.D.

Burns, E., and Kittredge, W. E.: Subcapsular Orchectomy in Advanced Prostatic Carcinoma. *Surg. Clin. N. America*, 1943, p. 1367.

Orchectomy in reference to prostatic carcinoma is discussed and the literature is briefly reviewed. The indication for this operation is considered to be any case which has spread beyond the limits of surgery.

A method of orchectomy is described and the technique is illustrated in a series of illustrations which are self-explanatory and show each step. The method consists essentially in shelling out the testicular contents from the capsule, ligating the bleeders, and sewing up the capsule, tunica vaginalis, and skin with a small drain in the lower angle of the wound. The value of the subcapsular operation is considered primarily psychogenic.

Twenty-three cases are reported in which there were no operative deaths. In 7 instances there was a reduction in the size of the carcinomatous gland; however, it was thought that the previous transurethral resection had influenced this particular finding. Twelve patients were completely relieved of pain. In 1 instance bony metastases were halted and in another the bony lesions demonstrated regression. In the remaining instances the metastatic lesions progressed without interruption. Two patients with edema of the legs were benefited with transurethral resection and orchectomy. In the individuals experiencing symptomatic relief there was a general sense of well being along with an increase of weight averaging 9 lb. for the group.

ROBERT LICH, JR., M.D.

MISCELLANEOUS

Vose, S. N.: Newer Concepts of Gonorrhea. *N. England J. M.*, 1943, 229: 610.

Gonorrhea is discussed from the aspect of public health, therapy, and diagnosis. The present trend toward elevating the economic standards of workers suggests that more patients with this condition will seek medical care from their private practitioner rather than from clinics. This trend places a greater responsibility on the private physician to maintain the standards of health and epidemiology. The physician can maintain the high standard of follow-up and discovery of contacts by making use of the supplementary services provided by agencies established by both local and federal governments.

The use of cultures is stressed as the best means of diagnosis in gonorrhea. However, this method offers considerable difficulty in the office of the practitioner, and it is suggested that such facilities as are available in the community be used so that the patient as well as the physician has the benefit. The ordinary smear is useful for observing the progress of the disease after the diagnosis has been made. Furthermore, it is pointed out that the culture is not the final authority and that it must be used only as a diagnostic aid along with careful subjective and objective study.

In "chronic gonorrhea" it is to be determined whether or not the infection is due to the gonococcus or to some secondary organism. In this respect the positive culture is of some value, but a negative culture is not a positive proof. The complement-fixation test is not all that is to be desired and therefore it is essential that the diagnosis is dependent upon the keenest diagnostic acumen. The most frequent causes for "chronic gonorrhea" are: (1) urethral stricture of large caliber, (2) prostatovesiculitis, (3) cervicitis, and (4) adnexal involvement. Cure is defined as a state in which not only the symptoms disappear, but the tissues return to normal.

Sulfathiazole given over a five-day period in a total dosage of 20 gm. is considered the most acceptable form of therapy at the present time. In addition the patient must be fortified by hygienic living along with avoidance of sexual activity and alcohol. An increased fluid intake is advantageous, and interference with the patient's occupation is unnecessary as a general rule.

In the event that the individual case is resistant to sulfathiazole therapy, several methods of therapy are available: (1) use of another sulfonamide, (2) a period of bed rest for from ten days to two weeks, (3) local treatment such as was common before the days of sulfonamide therapy, (4) fever therapy, and (5) penicillin. The last named method is still under extensive investigation; however, early reports seem to indicate extreme usefulness.

The prevention of gonorrhea is a field which offers the physician great opportunities. The patient's continuation of treatment must be insisted upon, the cases must be reported to local health authorities along with such information as can be obtained concerning contact. Also, the individual who has lapsed with therapy should be reported so that he may be contacted and thus stimulated to continue treatment and prevent his being a carrier.

Prophylaxis has been changed little in recent years and the author suggests micturition with washing of the genitalia with hot water and soap as being the most successful method, and this can be augmented, to give further assurance, by the injection of 1 per cent protargol into the urethra and the application of calomel ointment to the genitalia. The recent reports concerning the efficacy of sulfathiazole as a prophylaxis are promising, but it appears that the repeated use of this method is not without danger because of the possibility of sensitization to the drug and the cumulative effects. Although this method is apparently of benefit, since it seems to have reduced the incidence of gonorrhea and chancroid in the exposed soldier, it needs additional study before it can be recommended for general use.

ROBERT LICH, JR., M.D.

SURGERY OF THE BONES, JOINTS, MUSCLES, TENDONS

CONDITIONS OF THE BONES, JOINTS, MUSCLES, TENDONS, ETC.

Brown, R. C., and Ghormley, R. K.: Solitary Eccentric (Cortical) Abscess in Bone. *Surgery*, 1943, 14: 541.

Data on 24 additional cases of eccentric minute lesions of bone (cortical abscesses) are presented. The following observations support the hypothesis that the condition is due to trauma or infection rather than tumor:

1. Microscopic evidence of formation of tumor was not seen in 14 of the 24 cases in which the specimens were examined microscopically.

2. Definite destructive and inflammatory changes, not only of a fibrous nature, but also of a more acute one, were observed.

The roentgenological examination is the greatest aid in diagnosis, the picture being definite. The minute exciting lesion is seen; it is radiolucent and located within or beneath the cortex, but most commonly it is found in the osteoplastic reactive portion of the periosteum.

Surgical excision is the treatment of choice. Removal of the exciting portion is sufficient, only a small region being attacked.

Buck, R. M., McDonald, J. R., and Ghormley, R. K.: Adventitious Bursas. *Arch. Surg.*, 1943, 47: 344.

Adventitious bursas develop in fibrous connective tissue. They are not present at birth but are acquired. The process is one of mucoid or myxomatous degeneration of the connective tissue. This process appears to be degenerative rather than secretory. Repeated trauma of soft tissue over a bony prominence seems to be the causative factor. Adventitious bursas have no true lining, while true bursas have an endothelial lining.

Pelner, L.: The Rapid Removal of Excess Joint Fluid by Acid Salts. Experiments with Traumatic Hydrarthrosis of the Knee Joint. *Am. J. M. Sc.*, 1943, 206: 498.

Traumatic hydrarthrosis of the knee joint associated with ligamentous sprain are often encountered without any demonstrable cartilage injury or intra-articular fracture.

Three patients showing traumatic hydrarthrosis of the knee joint were given a low-salt, acid-ash diet with no restriction of the fluid intake, a daily dose of 6 gm. of ammonium chloride, bed rest, and an icecap to the injured part. In 1 patient the swelling of the knee joint was reduced at a rate of 0.5 cc. a day, and he was soon able to return to work. The second patient's knee was aspirated and 90 cc. of xanthochromatic fluid was obtained. A compression dressing was applied. Within twelve hours the fluid had reaccumulated and the temperature had risen to 103° F. A second paracentesis was done and 150 cc. of bloody fluid was evacuated. A circular cast was applied. Two weeks later the patient was able to return to work. After a period of six months this man injured his knee again. In spite of bed rest and an icecap to the swollen knee, the condition did not improve after the elapse of three days. The patient was then put on the special diet and ammonium-salt therapy. Within one week the swelling had disappeared and the patient became ambulant with a compression ace bandage applied to the knee. A similar course was observed in the third case.

Another group of 3 cases could not be treated by the method mentioned, and served as controls. One patient was treated with bed rest, salicylates, and short-wave therapy. The second patient did not tolerate ammonium chloride and was treated with short-wave therapy and a compression bandage. The third patient's knee was tapped twice, and finally a plaster cast was applied. All of these cases showed considerable residual swelling after the elapse of eight weeks, seven weeks, and four weeks, respectively.

Physiological considerations of the functions of synovial fluid and edema seem to justify the success of the dietary and ammonium-salt therapy.

The synovial fluid has an extremely close connection with the blood stream. Glucose taken by mouth reaches the knee joint quite rapidly. It has been shown that inert particles placed within the knee-joint cavity are absorbed by the capillaries or lymphatics, with the help of leucocytic or macrophage phagocytosis. The synovial membrane consists of a villous type of inner membrane which is covered with mucin-filled cells and an outer fibrous layer. The synovial fluid is formed by lymph plasma from the capillaries in the synovial membrane and the mucin from the synovial cells.

Edema is an increase of interstitial fluid. It accumulates only if it is able to retain the material it holds in solution. One thousand cubic centimeters of edema fluid consist of 8 gm. of sodium chloride and 2 gm. of sodium bicarbonate in 1,000 cc. of water—a solvent for these salts. The acids of the metabolism, or ingested acid substances, bind the bicarbonate fraction of the sodium salt and free the water. The water may leave the body by way of the kidneys, as water vapor, or remain in the body by shifting into the cells and thereby remedy cell dehydration.

Many other investigators have shown that the volume of joint fluid in rheumatoid arthritis can be beneficially influenced by the use of the described therapy. GEORGE I. REISS, M.D.

Stanford, S., and Horne, E. A.: Malignant Synovioma. *J. Bone Surg.*, 1943, 25: 883.

A case is reported of a malignant tumor of the right knee joint in a sixteen-year-old girl. The diag-

nosis was made by biopsy and a high thigh amputation performed. Pulmonary metastases were demonstrable roentgenologically six months later.

The tumor caused a marked thickening of the synovial surfaces of the knee joint and invaded the adjacent soft tissues, the patella, and the tibial tubercle. Microscopic examination showed a polymorphous tumor with cells arranged in sheets, parallel columns, and rosettes. A papillomatous type of growth was also noted. Many of the tumor cells were globular with vacuolated cytoplasm which indicated histiocytic lipophagic differentiation. Reticulin fibrils and some mucin were demonstrated by special stains.

The medical literature contains references to about 25 previously reported cases of malignant synovioma. Biopsy and early amputation would seem to be the treatment of choice. CHESTER C. GUY, M.D.

SURGERY OF THE BONES, JOINTS, MUSCLES, TENDONS, ETC.

Key, J. A.: The Choice of Operation for Delayed Union and Nonunion of Long Bones. *Ann. Surg.*, 1943, 118: 665.

When a fracture of a long bone fails to unite after a sufficient interval of time, operative intervention is usually indicated. The object is to provide extra bone for the bridging of gaps, filling of defects, and increasing stability; stimulate sufficient osteogenesis to result in bony union; and immobilize the fragments in a satisfactory position until union occurs. Other things being equal, the sooner the condition is recognized and treated, the better the chance of success and the less time lost by the patient. Consequently, early recognition of impending nonunion is valuable and decision on the part of the surgeon is necessary. He should avoid subjecting a patient to an unnecessary operation.

With the added insurance against infection provided by the local use of sulfonamide powder in the wounds, operation for the correction of delayed union and nonunion of fractures should be performed earlier than in the past. In addition to the sulfonamide in the wound, which the author now uses routinely in all operations, the patient is given sulfathiazole or sulfadiazine by mouth (1 gm. every six hours) for one or two days before, and three or four days after the operation if the nonunion is present in a bone which has been infected during the preceding year.

The surgeon should choose an operation which he is able to perform satisfactorily and which can be expected to result in union of the fragments in good position. Now that operations for nonunion are performed earlier than in the past, the choice of operative procedure is broadened. In some instances the fragments are firmly held in good position and osteogenic stimulus is needed; in others internal fixation is necessary; and in a third group extra bone is indicated for filling defects or increasing the strength of the bone. One should leave as little foreign material as possible in the wound. With the use of stainless steel and vitallium this is less important than in the past, but still it is advisable to use as little metallic internal fixation as possible, especially in bones which have been infected, and in subcutaneous areas. The simpler procedures are less apt to be followed by postoperative complications, but they will not solve the more difficult problems. A relatively simple operation, if undertaken early, may save the patient's time, avoid a difficult late operation, and result in a better limb.

Indications for the various forms of operative procedures are enumerated and the expected postoperative-union time is estimated. Significant surgical details are discussed for each procedure. In the order of their complexity the operations which are most useful are: (1) multiple drilling of the fragments; (2) open reduction and internal fixation, with or without multiple drilling of the fragments; (3) step-cut operations; and (4) various types of bone grafts, with or without other internal fixation. Each has its own sphere of usefulness and all should be followed by adequate external fixation—usually a plaster encasement.

ROBERT P. MONTGOMERY, M.D.

Kelley, J. B.: A Study of Subtrochanteric Osteotomy. *J. Bone Surg.*, 1943, 25: 768.

Of a series of 100 patients subjected to subtrochanteric osteotomy, 8 required reoperation because of poor position of the hip. Operation was recommended in 3 others, which made a total of 11 in which the condition was not satisfactory. The remaining 89 patients were considered to have satisfactory end-results. Each of the 8 patients who had a second operation had a satisfactory position following the second operation. The average length of time required to obtain sufficient union to allow weight bearing was ten weeks.

The operation was performed on 59 patients with fused hips and on 41 with mobile hips.

The youngest patient operated upon was two years old, and the oldest, thirty-two years.

From an analysis of 100 consecutive cases of subtrochanteric osteotomy the following recommendations are made:

The ideal position in cases of fused hips is that of 25 degrees of flexion, neutral lateral position, and neutral rotation. Patients whose hips are fused in this position have the best gaits, and do not complain while sitting, standing, or walking. In those cases in which the shortening is more than 1½ in., from 5 to 10 degrees of abduction are recommended.

A high curved subtrochanteric osteotomy is recommended to correct deformities at the hip joint when operation on bone is indicated. Abduction, adduction, flexion, and rotation can be readily corrected without sacrificing leg length.

The position desired to produce a successful result can be obtained by attention to detail. When the osteotomy has been performed, the opposite hip should be flexed, and the lumbar spine flattened.

The extremity should be held in the desired position, with the aid of assistants if necessary, until the fragments are immobilized in plaster. The operator should use a goniometer, if he is not satisfied with his clinical estimate of the position.

The difficulty of immobilizing the pelvis is recognized. A snugly fitting plaster-of-Paris spica, extending well above the nipples, is necessary. The opposite hip should be in abduction.

When a subtrochanteric osteotomy is done in the presence of a mobile hip, the use of the Roger Anderson pin apparatus or skeletal traction may be of assistance to the operator in controlling the fragments. The apparatus should not be used unless the operator is trained in the technique, and is aware of the attendant dangers.

ROBERT P. MONTGOMERY, M.D.

Key, J. A.: Internal and External Fixation of High Osteotomies of the Femur. *J. Bone Surg.*, 1943, 25: 737.

A high osteotomy of the femur is not an ideal procedure because it does not give a normal hip; but it is an operation which not infrequently can be used to solve a difficult problem in a satisfactory manner. In the author's experience, it is most often indicated in the treatment of hypertrophic arthritis of the hip (malum coxae senilis), and fractures of the neck of the femur which have not united and in which the head is living. The author has not used this operation in the presence of a dead head, and he does not claim knowledge as to whether or not it would yield a useful hip in such a case.

A description of the McMurray osteotomy as done by Key is given in detail and pertinent features are discussed. The inward displacement of the distal femoral fragment is regarded as being of more importance than the exact angle of abduction. A projecting tongue of cortex on the lateral aspect facilitates transfixation of the fragments with one or two noncorrosive metal screws.

Plaster boots are applied to each extremity, and these are fixed with a plaster bandage to a board to control rotation and maintain about 30 degrees of abduction. These are worn from two to four weeks. The patient can sit up in bed or be turned on the side or face. At the end of four weeks or less the casts are removed, and the patient is permitted to get up on crutches, but he is cautioned not to bear too much weight on the leg. In some cases no external fixation was used, but the patients were quite uncomfortable during the first few days after the operation and lost some abduction. Consequently, the use of abduction plaster boots is advised for at least two weeks. ROBERT P. MONTGOMERY, M.D.

Harmon, P. H.: Hemangioma of the Synovial Membrane of the Knee Joint Cured by Synovectomy. *Arch. Surg.*, 1943, 47: 359.

A case of hemangioma of the knee joint is reported. The disease is rare. Symptoms are relatively nondisabling and nonprogressive. In most cases the symptoms have been present for years before the surgeon is consulted.

The chief symptoms are recurring attacks of pain, swelling, and limitation of motion. Hemangioma of the synovial membrane has never been noted in more than a single joint in each patient. The characteristic recurrent attacks are marked by an elastic, doughy swelling which disappears on elevation of the extremity. In nearly all cases in which aspiration of the joint was carried out, bloody fluid was obtained.

The case reported was that of a male, aged nine years. The knee had remained consistently swollen with some intermittent slight to moderate pain, associated with diminution in motion for five years.

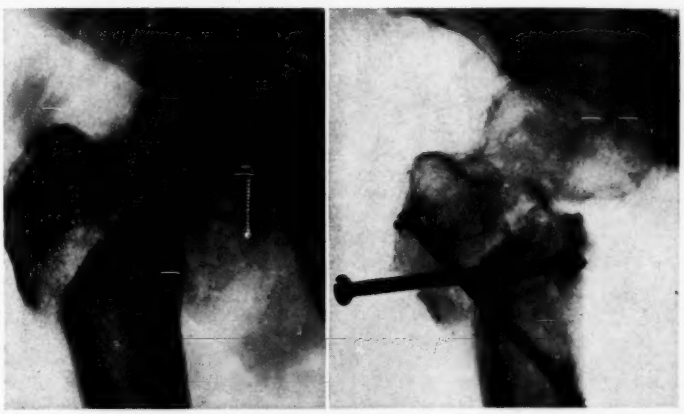


Fig. 1. Left, a nonunion after a McMurray osteotomy. Right, at second operation fragments were fixed with two screws. The feet were immobilized for four weeks in plaster boots fixed to a board. The horizontal screw became loose and was removed after union was firm.

There was never any increased temperature of the knee and no sinus formation. Bloody fluid had been aspirated from the joint on two occasions. Blood examinations and platelet count were normal. Coagulation time averaged five minutes, and the bleeding time one minute; the sedimentation rate was 10 mm. in sixty minutes.

Roentgen examination of the knee prior to operation showed multiple small areas of subcortical absorption beneath the articular cortex of the tibia. Hemophilia was ruled out. Operation was recommended since a tumor of the synovial membrane was suspected. The left knee was opened and the synovial membrane was found to be greatly hypertrophied, brick red in color, and shaggy in appearance. A moderate amount of serosanguineous fluid was present. Eighty per cent of the synovial membrane was resected. The incision was closed and a firm compression bandage applied around the knee. The subsequent course was uneventful. The patient was discharged on the twenty-sixth postoperative day. Range of motion was two-thirds of normal with painless weight bearing. The patient has been followed up for two and one-half years since operation and there has been no return of the swelling to the knee.

It is imperative that a constrictor be applied proximal to the site of the tumor during the operation.

Pathologists recognize two gross forms of hemangioma of the synovial membrane. Malignancy is rare. Microscopically there are large irregular blood vessels contained in a stroma. The size of the vascular area varies. A permanent cure in this type of case is often possible. RICHARD J. BENNETT, JR., M.D.

ORTHOPEDICS IN GENERAL

McCarroll, H. R., and Schwartzmann, J. P.: Spastic Paralysis and Allied Disorders. *J. Bone Surg.*, 1943, 25: 745.

The importance of spastic paralysis, and the allied disorders often confused with this malady, is readily understood in view of the fact that in frequency it ranks second only to poliomyelitis in the average clinic for crippled children in this country. Many children are added to the list of sufferers each year, a few of whom can be helped considerably, while many others show involvement to such a degree that little can be accomplished with treatment, and little hope can be held out for their spontaneous improvement. The very nature of the condition is such that we will probably always be confronted with this problem; therefore, it is necessary that we understand the problem as clearly as possible in order that we may offer the maximum benefit to the patients with adequate prerequisites for treatment.

A series of 1,720 consecutive cases of spastic paralysis and allied disorders is analyzed from the standpoint of classification, characteristics of each class, and etiological factors. The 1,217 cases of lesions of the pyramidal tract are discussed in detail from the standpoint of the extremities involved, associated conditions, requirements or prerequisites for surgical correction of the deformities, and reasons for nonintervention in those cases rejected for surgery. The deformities encountered in both upper and lower extremities are then discussed together with the various operations which have been used, and the results obtained. An attempt is made to establish some rationale for the selection of the most desirable operation in each type of deformity. Contraindications for operative therapy are discussed and emphasized.

The total number of operations on the upper extremities was 115, with only 16 good results. Surgical treatment on the whole is unsatisfactory, with improvement primarily cosmetic, not functional. Attempts at correction of deformities in the upper extremity are justified for pronation of the forearm and flexion of the wrist.

The total number of operations on the lower extremities was 1,063, with 677 good results. Surgical treatment on the whole is satisfactory, and should be attempted for adduction of the thighs; internal rotation of the thighs; flexion deformity of the knees; spasm or contracture of the heel cord; and other fixed foot deformities. ROBERT P. MONTGOMERY, M.D.

SURGERY OF THE BLOOD AND LYMPH SYSTEMS

BLOOD VESSELS

Coleman, F. P.: Transpleural, Intrathoracic Ligation of the Left Common Carotid Artery. *J. Thorac. Surg.*, 1943, 12: 659.

The surgical approach to the common carotid artery has remained surprisingly constant. Heretofore, it has been ligated in the neck in spite of the presence of infection, malignancy, cervical hematomas, or secondary hemorrhage. A review of the availabe lliterature has failed to reveal any reference to a transpleural, intrathoracic approach for ligation of the left common carotid artery.

Such an approach was employed by the author in a twenty-one-year-old white soldier with a malignant melanoma of the neck. The local lesion had been excised elsewhere four months previously, only to recur in a lymph node at the angle of the left mandible. Twelve days following the patient's admission to the hospital a radical dissection of the neck gland on the left side was performed under gas-oxygen-ether-vapor anesthesia. On the twenty-fifth postoperative day, a large hematoma appeared in the neck at the junction of the transverse limb with the vertical limb of the scar. The hematoma was evacuated and promptly a massive hemorrhage amounting to 600 cc. of blood resulted before the bleeding could be controlled by digital compression. Under local anesthesia, the wound was opened wide. There was a gross ulceration of the common carotid artery at the site where the external carotid artery had been ligated. It was not possible to ligate the common carotid artery proximal to the site of bleeding. A mass ligation of double chromic No. 2 catgut was passed on a needle beneath the common carotid artery, and two additional mass sutures of chromic No. 2 catgut were placed immediately about the bleeding point. On the second postoperative day, it was obvious that this occlusion of the common carotid artery would not be sufficient to prevent a fatal outcome. Pulsations in the artery below the thyroid cartilage were still present. The infection had descended to a level of the clavicle and this rendered an approach to the common carotid artery at a lower level in the neck impractical.

A transverse skin incision was made over the second intercostal space beginning at the lateral border of the sternum on the left and extending to the anterior axillary line. The pectoralis major and minor muscles were divided in a line with their fibers and the left pleural cavity was entered through the second intercostal space. The internal mammary vessels were doubly ligated and divided. It was not necessary to divide the rib cartilage. A rib spreader was introduced and the upper lobe of the lung was covered with a moist pack and retracted downward until the superior aspect of the hilus of the lung was visible. The mediastinal pleura was opened over the arch of the aorta and the incision extended upward for a distance of 3 in. midway between the phrenic nerve anterior and the vagus nerve posterior. On dissecting the posterior leaf of the mediastinal pleura with the vagus nerve, the subclavian artery was easily exposed and identified. The anterior leaf of the mediastinal pleura was now mobilized with the phrenic nerve and the left common carotid artery came readily into view. Two ligatures of No. 8 braided silk were tied 1 cm. apart about the left common carotid artery 2 cm. from the arch of the aorta. The mediastinal pleura was closed with interrupted sutures of fine silk. The pleural cavity was washed with physiological saline solution. The

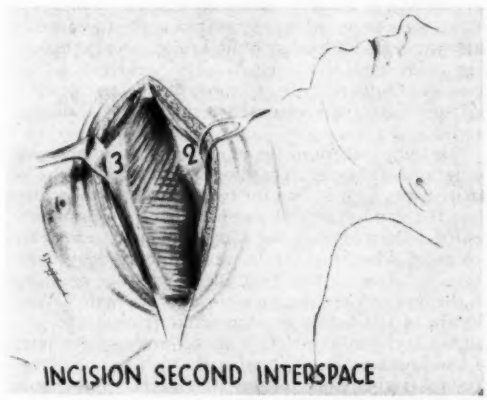


Fig. 1. Incision of second interspace. Surgical approach.

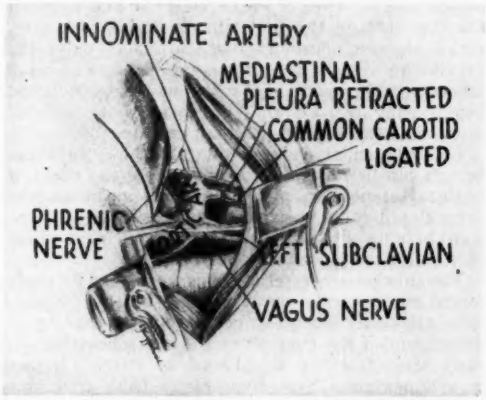


Fig. 2. Exposure of left common carotid. Note adaptability of subclavian and innominate arteries to ligation.

lung was re-expanded by positive pressure and the pleural cavity and wound were closed without drainage. The patient had entirely recovered on the twenty-first postoperative day, with the exception of the neck wound where healing was completed forty-two days after the second ligation of the left common carotid artery.

It appears as if the transpleural, intrathoracic approach would find a field of usefulness in the management of an actual or an impending hemorrhage secondary to a diffuse neck infection, in arteriovenous fistulas and aneurysms situated low in the cervical region, and in traumatic injuries of the neck accompanied by massive hematomas. In such incidences it is suggested that this approach may be used alone, or in combination with some other suitable procedure in the cervical region.

It is anatomically feasible to use a left-sided approach in ligating the first part of the left subclavian, the left common carotid, and the innominate arteries. Through a right-sided approach it is possible to ligate the innominate, the right common carotid, and the first part of the right subclavian arteries.

JOSEPH K. NARAT, M.D.

Falconer, M. A., and Weddell, G.: Costoclavicular Compression of the Subclavian Artery and Vein: Relation to the Scalenus-Anticus Syndrome. *Lancet*, Lond., 1943, 245: 539.

It is noted by the authors that a number of views have been put forward as to the mechanism of the vascular disturbances produced in the arm by a cervical rib or sometimes by a first thoracic rib. This article describes 3 cases in which there was evidence of intermittent compression of the subclavian artery and vein between the clavicle and first thoracic rib. A fourth case with neurological disturbances only is also described.

In one of the cases in which cervical ribs were demonstrated the subclavian artery was being compressed at two places—between the scalenus anterior muscle and the apex of the cervical rib; and between the clavicle and the first rib. In the fourth case, which showed neurological disturbances only, the subclavian vessels were not compressed, and relief was obtained by section of a fibrous band which was compressing the C8 and T1 nerve roots without division of the scalenus anterior muscle.

Costoclavicular compression of the subclavian vessels can be recognized by observing the effect of postural maneuvers of the shoulder girdle on the arterial pulses of the limb. Backward and downward bracing of the shoulders is the movement which obliterates the pulses most readily.

The subclavian vessels can be compressed by these forced maneuvers in many normal subjects. Symptoms arise only when this compression is easily provoked, and if the compression is not relieved at an early stage features of obliterative arterial disease may supervene. Symptoms range from cold blue hands with a tendency to chilblains in the mildest group of cases, to "Raynaud attacks," arterial thromboses, and even gangrene in the more severe cases.

In the past these cases have been confused with those of the "scalenus-anticus syndrome." They may be differentiated by paralyzing the scalenus-anterior muscle with a local anesthetic.

In milder cases the authors note that benefit may be obtained by remedial exercises designed to increase the postural tone in the muscles of the shoulder girdle. In more severe cases operation is required and is best begun under local anesthesia. The site of compression of the subclavian artery between the clavicle and the first rib is demonstrated by getting the patient to brace his shoulders backward and downward. In positive cases the tip of the forefinger is nipped between the clavicle, and the radial pulse disappears. When a compression at this level is present, the essential part of the operation is removal of a segment of the offending rib from beneath the artery, for division of the scalenus-anterior muscle alone may be ineffective.

HERBERT F. THURSTON, M.D.

Barber, R. F., and Madden, J. L.: Spontaneous Closure of an Arteriovenous Fistula: Report of a Case. *Arch. Surg.*, 1943, 47: 364.

The case report is of a male negro, twenty-four years of age. There was a history of having been stabbed in the right groin with a paring knife, the blade breaking off in the soft tissues of the thigh. The patient was in shock because of acute loss of blood. The blade was removed and bleeding was controlled by means of a pressure bandage. The temperature, pulse, and respirations were within normal limits. The blood pressure was 70/40.

In the right femoral region, 1½ cm. below the middle and inner third of the inguinal ligament, there was a stab wound 5 mm. in length, transverse to the long axis of the extremity. Below the wound was a hematoma measuring 5 cm. in its greatest diameter. Seven hours later there was no active bleeding and no increase in the size of the hematoma. Palpation of this area revealed a pronounced thrill and auscultation revealed a loud systolic bruit. The extremity was warm distal to the fistula. The peripheral pulsations were full and equal to those of the opposite leg. A diagnosis of right femoral arteriovenous fistula was made.

The temperature of the skin showed no abnormal variations. The electrocardiogram was normal. The patient was kept in bed for twelve days, after which time the surface wound was found to be completely healed. Variations in the blood pressure were demonstrated when the fistula was obliterated by compression. During this time blood-pressure readings of the upper extremities were 150/80 each. After closure of the fistula similar readings were 150/110 (right) and 160/110 (left). Blood-pressure readings of the lower extremities with the fistula open were 160/70 (right) and 168/90 (left). The pulse rate with the fistula open was 82 beats per minute, and on closure of the fistula 60 beats per minute.

Three months after the original injury the arteriovenous fistula in the right femoral region was still open. Six months after the original injury the patient was admitted to the hospital for elective operation. Examination at this time revealed the arteriovenous fistula to be completely closed.

It is suggested that any attempt to close an arteriovenous fistula by operation should be delayed for a period of six months and then if there is even a diminution in size of the opening between the artery and the vein further observation should be carried out. RICHARD J. BENNETT, JR., M.D.

BLOOD; TRANSFUSION

Ochsner, A., and DeBakey, M.: Intravenous Clotting and Its Sequelae. *Surgery*, 1943, 14: 679.

Intravenous clotting is of great importance because of its potential sequelae.

It is necessary to differentiate between the two types of intravenous clotting, phlebothrombosis and thrombophlebitis. The thrombus in the former is loosely attached and is likely to become detached and cause an embolism. Embolism in thrombophlebitis occurs infrequently because the thrombus is firmly attached to the vein wall. Only when a coagulation thrombus, which is a red clot and is not attached, forms proximally to the thrombophlebitic area, or when suppuration occurs with liquefaction of the clot, does embolism occur in thrombophlebitis.

In phlebothrombosis, embolism and its complications are the important sequelae. Embolism may result in a sudden fatality because of massive plugging of the pulmonary arteries. In other cases of pulmonary embolism the clot is smaller, producing obstruction in the smaller branches of the pulmonary artery. This results in infarction of the lung, which is of importance not only because of its associated pneumonitis but also because it is a warning that the patient has a focus from which emboli can originate and produce a fatal embolism.

The sequelae of thrombophlebitis are divided into two types, those which follow the nonsuppurative variety, the most common, and those which follow the suppurative lesions. Nonsuppurative thrombophlebitis may result in postphlebitic edema, streptococcic infection, and/or ulceration. Following the suppurative variety, embolism is the most important sequel. This may result in septic infarction with the development of pneumonitis or pulmonary abscess and even sepsis.

The treatment of most of the intravenous clottings and their sequelae consists principally in preventing the thrombosis. Any trauma produces changes in the constituents of the blood, which predispose to clotting. If in addition to these changes there is circulatory retardation, which is likely to occur in the lower extremity, intravenous clotting is favored. By minimizing the operative trauma, the tendency toward thrombosis can be decreased. Of greatest importance, however, is the prevention of circulatory retardation in patients who have had tissue trauma with resulting blood changes. Retardation of the circulation may be prevented by eliminating vasospastic influences such as exposure to cold, and smoking; by the correction of cardiovascular disorders; and by preventing stasis within the vascular system by overcoming abdominal distention, by encouraging deep breathing, and by mobilization of the extremities.

The prophylactic therapy for embolism in phlebothrombosis consists of measures to prevent the detachment of the clot with resulting embolism. The clinical manifestations of phlebothrombosis are not marked, and it is for this reason that the condition is likely to be overlooked unless one considers the possibility of its existence. Of diagnostic importance is the detection of tenderness along the course of possibly involved veins of the foot or calf. In the absence of other causes, tachycardia associated with an increase in erythrocytic sedimentation rate is of diagnostic aid. Enlargement of one or of both extremities is suggestive of beginning thrombosis.

If any of these symptoms and signs are present one must suspect an intravenous clot, and phlebography is imperative. This will not only demonstrate the presence or absence of a clot but will also give its location. The technique of phlebography as practiced by the authors is described.

If phlebography demonstrates the presence of an intravenous clot it is imperative that steps be taken either to remove the clot or to prevent its migration into the systemic circulation. According to the location of the clot, the vein should be exposed; then the vein should either be tied above the clot or it should be opened and the clot removed. An operative description of vein ligation is outlined.

The active therapy of a patient with pulmonary embolism depends to a large extent upon the type of embolism. If there has been a massive pulmonary embolism the following measures are advocated: intravenous administration of papaverine and atropine, novacaine block of the cervicodorsal sympathetic ganglia, and inhalations of oxygen. Pulmonary embolectomy is not advised. For the patient with pulmonary infarction, the administration of oxygen and sulfonamides is advised.

The prophylactic treatment of postphlebitic edema consists of the production of vasodilatation during the acute phase of thrombophlebitis by repeated procaine anesthetization of the regional sympathetic ganglia. The patients can be perfectly well within a week or ten days if this conservative therapy is used. Daily procaine injections of the sympathetic ganglia should be made as long as the patient has fever, which is an indication of the persistence of the thrombophlebitic process. This process results in spasm of the arterioles, which in turn is responsible for the edema. In addition to the vasodilatation secured by the procaine block of the regional sympathetic ganglia, it is important that the extremity be wrapped with compression bandages. This is best accomplished with an Ace No. 8 bandage which is wrapped from the toes up to the upper limit of the

swelling. Immediately after the application of the compression bandage, the extremity should be mobilized. Active flexion of the foot against resistance from ten to fifteen times every hour is of great value in these cases.

There are many cases in which active therapy was not used during the acute thrombophlebitis so that postphlebitic edema developed. There are few lesions which are more disabling than the edema which follows a phlebitis which had been acute many years previously. Most chronic postphlebitic edemas can be relieved by the institution of vasodilatation by procaine block of the regional sympathetic ganglia. Other conservative measures may also be used. These consist of reflex vasodilatation by the application of heat to an uninvolved portion of the body. This can be accomplished either by immersing an uninvolved extremity, such as the arm, in hot water two or three times a day for about thirty minutes, or by the application of a hot-water bag or heating pad to the abdomen after retiring at night. It is imperative that the patients avoid vasoconstricting measures such as chilling and smoking. Of great importance in the conservative treatment of thrombophlebitis is the compression of the involved extremity by wrapping the extremity with Ace No. 8 bandages as described. The bandage should be applied in bed before the patient arises in the morning and removed upon retiring at night. The administration of relatively large doses of vitamin B_1 is of value.

In the severe case of postphlebitic edema, resection of the regional sympathetic ganglia to produce a permanent vasodilatation is desirable.

Recurrent streptococcal infections may occur in patients who have had postphlebitic edema over a long period. They are characterized by recurrent attacks of chills and fever associated with burning, itching, pain, and redness of the extremity. There is deposited in the skin and subcutaneous tissues a considerable amount of fibrous tissue resulting in a true elephantiasis, and characteristically the condition becomes worse with each attack. This is best treated prophylactically by using the same measures used for the prevention of postphlebitic edema. The active therapy of this recurrent erysipeloid condition consists, first, in producing vasodilatation by the same measures which are used in postphlebitic edema. In addition, compression and active mobilization of the extremity are essential and sulfonamide therapy is necessary. The patients should receive from 4 to 6 gm. of sulfadiazine a day for a week of each month. In a case in which the condition has been present for a long time it is occasionally necessary to resort to a radical procedure such as a modified Kondoleon operation, because only by such therapy can excessive subcutaneous fibrous tissue which is responsible for the persistence of the edema be removed.

Another infrequent complication of thrombophlebitis is postphlebitic ulceration. For this also the treatment consists primarily of prophylaxis, and by the prevention of thrombophlebitis with subsequent edema, postphlebitic ulcerations can be prevented. The active therapy consists of the institution of vasodilatation, the use of compression bandages, and mobilization. Sulfonamide therapy is very helpful because of the frequent presence of streptococci in the ulcer and the surrounding tissues. As these cases also have varicosities of the superficial veins and of the communicating veins between the superficial and deep systems, these varicosities must be corrected before the ulcer will heal. The presence of one or more large communicating veins in the base of the ulcer, in which the valves are incompetent, makes it necessary to ligate these veins. It is usually desirable to excise the ulcer and surrounding scar tissue and cover the defect with a skin graft.

In suppurative thrombophlebitis, prophylaxis is of greatest importance. Ligation of the vein proximal to the site of the thrombus is imperative. Occasionally, excision of the involved vein is the preferable procedure, as is frequently the case in thrombophlebitis involving the superficial veins of the extremity. These same procedures are used as active therapy once the condition has occurred. The site of election for the vein ligation depends upon the veins involved and the extent of the process.

ERNEST E. ARNHEIM, M.D.

Bryce, L. M., and Jakobowicz, R.: The Hemoglobin Level in Blood Donors. *Med. J. Australia*, 1943, 2: 329.

The authors note that prior to the outbreak of war, a roster of some 400 voluntary donors was found sufficient to maintain the civilian blood transfusion service of the Victorian Division of the Australian Red Cross Society. Approximately 85 per cent of these donors were young men, and although hemoglobin estimations were made as part of the routine preliminary examination of volunteers, rejection because of anemia rarely occurred.

For war purposes many thousands of donors have been enrolled, the majority of whom are women. No volunteers are accepted whose hemoglobin level is less than 85 per cent. The hemoglobin content of all donors is re-examined after their second and subsequent donations.

Figures presented in this article are based on 18,600 estimations of hemoglobin value during the period of twenty-five calendar months from June 1, 1940, to June 30, 1942. Estimations have been made on a single hemoglobinometer of the Sahli type. This instrument was standardized by comparison of the readings obtained with those given by the oxygen-capacity method. The technique for the determination is described in detail.

Tabulations are presented showing the hemoglobin levels in donors before and after giving blood and separated as to sex; the hemoglobin levels at different ages on 3,418 donors; the hemoglobin levels in individual donors after successive donations; the rate of regeneration after blood donation and the hemoglobin levels after iron therapy.

The investigation was prompted by a realization that such a large group of donors gave opportunity for a survey which would be far less practicable in peace time. Moreover, relatives of donors are often fearful of the consequences. Effects of repeated donations of blood, from women especially, also were studied to learn if they were detrimental to the health of these volunteers. The amount of blood taken from these donors was usually between 500 and 600 cc. While it might be simpler to give iron to all donors, unless control tests are made, it is impossible to ascertain whether this has the desired results, and unless this matter is carefully handled from the "propaganda" aspect, it may, by its implication that blood giving is inevitably a harmful process, have an adverse effect on the recruitment of donors.

In conclusion, the authors note that the hemoglobin level prior to the giving of blood has been estimated in a series of 4,110 men and 8,956 women between the ages of eighteen and sixty-five years. The average level of hemoglobin was found to be 110.24 per cent in men and 99.47 per cent in women; these figures on the scale used are respectively equivalent to 15.43 and 13.93 gm. per 100 cc. of blood.

In a series of 815 men and 2,603 women, the average hemoglobin level at different ages was determined. It was lowest in the lowest age group (eighteen to thirty years) and highest in the highest age group (fifty to sixty-five years) in both men and women. The range was from 108.6 per cent to 109.7 per cent in the men, and from 96.5 per cent to 101.2 per cent in the women. No significant seasonal variation in the hemoglobin level was detected.

The hemoglobin level in a series of 1,577 men and 3,957 women, who had given blood on two or more occasions at intervals of not less than three months, was also estimated. No significant difference was found between the hemoglobin levels of men before or after giving blood. In women, 4.14 per cent had a hemoglobin level of less than 85 per cent before giving blood; this figure increased progressively after three or more blood donations to 9.75 per cent of those who had given five or more donations.

Factors affecting iron metabolism, particularly in women, and theoretical estimates of the time required for regeneration after blood donations are discussed. Data obtained in detail from 4 observations are shown. The effect of iron therapy is shown in 12 cases. The reasons and need for supervision of the hemoglobin level in voluntary donors are emphasized and the role of iron therapy is discussed.

HERBERT F. THURSTON, M.D.

Bruneau, J., and Graham, E. A.: A Caution against Too Liberal Use of Citrated Blood in Transfusions. *Arch. Surg.*, 1943, 47: 319.

The use of citrated blood for transfusion has become so common in the last twenty-five years that it would seem to be entirely safe if ordinary precautions are taken to resort to compatible blood and to avoid the presence of pyrogens. The authors, however, have had some experiences which have led them to question the innocuousness of sodium citrate itself, when injected in large quantity.

Since the first use of citrated blood for transfusions in 1915 it has been realized that too large doses of sodium citrate could prove harmful. After experiments on dogs, Lewisohn concluded that 15 gm. would be a fatal dose for a man weighing 125 lb. He advised that 5 gm. be the maximum dose used in transfusions. No mention was made, however, of the time over which such an amount could be given.

This experimental study reported by the authors was undertaken in an effort to determine the effects of the introduction of large quantities of citrated blood in a short period of time.

Dogs were bled and the blood, after hastily being mixed with an anticoagulant, was reinjected intravenously. Blood-pressure readings were obtained before each bleeding. At regular intervals, samples of venous blood were obtained from the site of injection for determination of the hematocrit values, clotting time, and calcium and phosphorus content. In one group sodium citrate was used and in the second group heparin was used as the anticoagulant. The experimental results are reported in detail.

In summary the authors note that dogs bled repeatedly, and continually given transfusions of citrated blood survived a much shorter time than controls receiving heparinized blood.

This difference seems to be due to the toxic action of large amounts of sodium citrate. The possible mechanism of its action is discussed on purely theoretical grounds.

The clinical implication of these findings is a warning against the too liberal use of large amounts of citrated blood over a very short time.

HERBERT F. THURSTON, M.D.

Lucas, H. K.: Transfusion in the Ambulance: Its Value in the Western Desert. *Lancet*, Lond., 1943, 245: 503.

A wounded man loses blood and blood plasma at the time of wounding, and this loss may be so severe as to cause circulatory collapse, or wound shock. However, a second and scarcely less important factor with the severely wounded is the further loss of plasma into the damaged tissues produced by movement during evacuation. This second loss can be largely overcome by setting up "travelling transfusions" in ambulance cars.

In the Western Desert resuscitation work met some special problems. The distances between battlefield and field ambulances or casualty-clearing stations (CCSs) varied from 20 to 120 miles, and the tracks were very bad. Most of the battles along the North African coast were fought in areas where the water supply was restricted to half a gallon per man per day for all purposes. Wounded soldiers, therefore, were not so well able to compensate their blood loss as were their fellow casualties in a well watered country.

The transfusion equipment of the Eighth Army units provided dry plasma for the regimental medical officer, dry and wet plasma or serum for the advanced dressing-stations, and plasma and blood for the main dressing stations. Blood for the field ambulances, to which no transfusion unit was attached, was issued from the advanced blood bank, which was a mobile supply unit consisting of one refrigerator truck and one stores truck.

During the summer months of 1942, before Alamein, all casualties passed through a single CCS, and it became clear that although it was possible to overcome a man's wound shock in a field ambulance, no guarantee could be given that circulatory embarrassment would not occur before he arrived at the next medical unit down the line.

A technique was devised for giving transfusions in transit. The arm is splinted with the elbow in 10 degrees of flexion and the palm firmly bandaged. The needle is inserted well into the vein and secured by a 4-in. strip of 3-in. elastic adhesive. With the fluid running satisfactorily, the patient is transported on a stretcher and placed in the ambulance with the transfusion arm in the "inboard" side. The bottle and drip-counter are then fixed in a holder. An orderly adjusts the rate of drip during the journey.

Experiments and trials have shown that the evacuation of casualties with transfusions in progress is a reasonable possibility, and greatly reduces circulatory collapse.

With abdominal wounds the initial shock is often severe, the adverse effect of travel is greater than in any other type of case, and the need for surgery is most urgent. A fact perhaps not widely recognized is that however serious may be the effect of movement before operation, it is much worse in the first six or seven postoperative days.

Recognition of these facts led to a standard technique in the desert, by which almost all abdominal injuries were treated. Whenever possible the injured were resuscitated with whole blood and operated on in selected forward field ambulances, to which surgical and transfusion units were attached. They were held and nursed in the field ambulance for from six to ten days, and in the event that the unit was ordered to move without being relieved by another unit, a detachment was left to care for them. It was the universal practice to employ continuous gastric suction and to give saline solution intravenously during the immediate postanesthetic period and for from four to seven days afterward. A recent analysis of 1,000 casualties shows that the average postoperative consumption of glucose-saline solution in the abdominal cases surviving operation by more than twenty-four hours was 17.6 pints from the time of operation to the time when fluids could again be taken by mouth.

Burn cases, of which the proportion in the desert was for various reasons abnormally high, probably come second to abdominal wounds in their poor response to travel. Generous administration of plasma or serum is accepted as beneficial.

Penetrating chest wounds, although not usually in need of extensive transfusion, also travel very badly, and soon produce shock. Travelling transfusions overcome this difficulty and should be used as a routine for such injuries.

Maxillofacial injuries often develop a degree of shock out of all proportion to the blood loss and tissue damage. The problem is to place them in the hands of a special unit at the earliest possible moment, and this can be best achieved by the use of blood transfusion during evacuation.

No case in which a patient with a travelling transfusion in progress has arrived at a medical unit in a state of shock has been traced.

JOHN E. KIRKPATRICK, M.D.

De Gowin, E. L.: Errors in Mass Blood Grouping and Methods of Minimizing Them. *War Med.*, Chic., 1943, 4: 410.

The occasion for the study of errors in mass blood grouping came when the author was requested to check the results of determinations of blood groups being performed in a certain military establishment. The technician detailed to that duty collected the specimens of blood, made the suspensions of red cells in isotonic solution of sodium chloride in small serological test tubes, and labeled them. He determined the blood group, recorded his results, and delivered both the specimens and the records to the author. The author then independently tested the same bloods by means of a similar method and, frequently, tested serums from the same source. Bloods which showed discrepancies were retested with serums which had been originally employed, as well as with reliable serums from other sources. This procedure disclosed errors due to the technique of the individual worker and, in some cases, errors attributable to defective serums. As the study was performed, possible mistakes in the labeling of the specimens were not detected, although such errors would have been noticed had two independent collections of blood been made from each subject.

An analysis of the rate of error of the different workers participating in this study is interesting. Among 5 technicians the percentage of errors ranged from 1.0 to 7.1 per cent.

The author concludes that no laboratory worker can perform mass determinations of blood groups without making appreciable errors due to the personal equation. These errors can best be detected by means of two independent collections of blood and two separate determinations of blood groups. Comparison of the results in the two series will lead to careful rechecking of the blood showing discrepancies.

The open-slide technique of determining blood groups is the quickest method for testing blood specimens on a large scale. The method is satisfactory with minimal agitation if typing serums of high titer are employed and the readings are made after thirty minutes at room temperature.

HERBERT F. THURSTON, M.D.

. SURGICAL TECHNIQUE

WAR SURGERY

Hurst, Sir H.: Peptic Ulcer and Dyspepsia in the Army. *Brit. M. J.*, 1943, 2: 473.

Transient dyspepsia tends to develop in new Army recruits before they become hardened to the routine. All measures should be taken to give the dyspepsia its full value, but on the other hand the investigation should not be allowed to go too far and make a chronic complainer out of the individual.

Articles on dyspepsia report that 80 per cent of the symptoms date back to civilian life, the average duration being seven years. Statistics collected in 1942 show that the average age is thirty-two and one-half years with two and one-half years of service. The duration of the symptoms was five and one-half years, and 75 per cent of them had their onset in civilian life.

When functional dyspepsia is diagnosed the symptoms are found to be far more resistant to treatment than those of ulcer. The longer the period in the hospital, the shorter the interval to the next recurrence. When investigation has shown the absence of organic changes, the men should be returned immediately to their units. These men should be returned to full duty and routine Army diet. Prolonged investigations tend to produce or to increase a psychoneurotic factor and the man progresses to being a useless soldier. Gastroscopy should be used only in those individuals in whom roentgenography suggests the presence of a neoplasm or ulcer.

Among one group of Army personnel 42 per cent were discharged from hospitals in Britain for nonulcer dyspepsia, while during that same period of time 3 per cent were discharged from the Army for the same condition. In the last war, up to the end of 1915, there were 709 discharges from the Army for inflammation and ulcers of the stomach, certainly a small number. Similar figures for peptic ulcer up to December 1941 were 23,574.

An analysis of 800 Army medical cards showed that 81 per cent of the symptoms began in civilian life and 19 per cent began in the Army. For the 19 per cent which began in the Army the average length of war service was two years, the age of the patients was thirty years and nine months, and the duration of the symptoms was nine months. With regard to gastric ulcer, the onset of symptoms occurred in civilian life in 73 per cent; the average previous duration of the symptoms was five years and six months, and the average age of admission was thirty-two years. Eighty-two per cent of the patients with duodenal ulcer had the onset of symptoms in civilian life, the average previous duration of symptoms was five years and seven months, and the average age of admission was thirty-one years and eleven months.

Among 118 cases of gastric ulcer, 90 of the ulcers were located on the lesser curvature; the average previous duration of symptoms was six years and one month, and the average age of the patient on admission was thirty-two years and eight months. The ulcer was located at the pylorus in 28 cases, with an average duration of symptoms of five years and eight months, and an average age of the patient of twenty-nine years and eight months. Thus most of the peptic ulcers in the Army are the end-result of recurrence of symptoms which started in civilian life.

Evidence has been accumulated which shows that ulcers do not form more rapidly, nor do relapses and recurrences occur more frequently, in the Army than in civilian life. It appears that the patients with peptic ulcer in the Army are more affected by not being able to obtain food at short intervals. All, with the exception of key men, who have an accepted diagnosis of peptic ulcer are discharged from the Army.

During the early period of the war, experience has shown that when men were returned to ordinary duty after treatment their symptoms returned consistently.

An accurate diagnosis is very important, for once the diagnosis of peptic ulcer is made it remains permanent. There was a 4 per cent incidence of complications among cases admitted to the hospital in the Army, while the incidence of complications among cases admitted in civilian life was 23 per cent. The number of perforations admitted to the hospital in civilian life exceeded that in the Army. An error may exist in these two sets of figures as they may not be based on the same factors.

There was a 35 per cent mortality from gastric ulcer due to perforation in patients over forty years of age and a 5 per cent mortality for those under forty years of age. The mortality from duodenal ulcer was 19 per cent in patients more than forty years of age and 14 per cent for those under forty years of age. In the series of 800 Army medical cases there were 13 perforations with no deaths among 125 patients under forty years of age. There were 17 perforations with 2 deaths from duodenal ulcer among 572 patients admitted to the hospital. From the 800 Army medical records it was seen that 26 men were admitted specifically for hemorrhage, with 1 death. All were under forty years of age and the 1 death took place in the only case in which operation was performed for the direct purpose of checking hemorrhage. The incidence of perforations and hemorrhage in peptic ulcer in the Army is about the same as in a similar group of the civilian population. An analysis of dyspepsia in a civilian hospital and in the Army indicates that the incidence in the two sexes is the same in the Army as in civilian life. There is no evidence that there is a large new development of peptic ulcer in the Army. Symptoms due to pre-existing peptic ulcer tend to recur in the Army. Of the patients admitted to the hospital for dyspep-

sia, 58 per cent were found to have peptic ulcer and 42 per cent had symptoms of nonulcer origin.

RICHARD J. BENNETT, JR., M.D.

Yudin, S.: The Treatment of Gunshot Fractures of the Limbs. *Brit. M. J.*, 1943, 2: 567.

The methods used in the treatment of gunshot fractures of the limbs are based on three main therapeutic factors: wide surgical excision of the wound, adequate local and general use of the sulfonamides, and prolonged fixation in plaster. These principles are indisputable, and surgical excision should not be replaced by chemical sterilization or the introduction of packing. In addition, the application of dry sulfonamide powders is immeasurably better than the use of other antiseptics or repeated irrigations, and allows adequate splinting with plaster, which is essential for complete immobilization of the limb. This immobilization is of paramount importance in the case of gunshot fractures, especially those of the femur, not only for procuring adequate union of the fracture and healing of the wound, but for the survival of the limb and even of the patient. Not only is immobilization in plaster the most important factor in the treatment, but it is most suitable for the transport of the patient over long distances.

The author does not consider it possible to procure adequate immobilization of the bone fragments and soft parts with hinged splints and other forms of apparatus. Plaster-of-Paris bandages are applied directly to the skin and immobilize the whole limb; thus they secure maximum rest and allow easy transport.

There are, however, three main drawbacks: (1) the defective position of the bone fragments may not easily be seen and serious shortening of the limb may result; (2) contractions and stiffness of the joints may occur; and (3) sepsis may progress unnoticed.

It is contended, however, that anyone who uses this method for gunshot fractures will never wish to return to any other. The condition of the wound and the granulation tissue which develops under the plaster are remarkable. It should be emphasized that the plaster must be put on only after wide excision of the wound and removal of all dead and damaged tissue.

Irrespective of time or condition, care of all cases consists in the removal of all large foreign bodies and bloodclots, and a thorough excision of all devitalized tissue. Bone fragments need much care, and only loose fragments should be removed. Excision of the surrounding muscles should be sparing and only such muscular tissue should be removed as is in danger of necrosis. After the excision no stitches should be used either in the skin or muscle, and the wound must be freely opened throughout to allow free drainage of the exudate. The whole cavity must be liberally filled with a sulfonamide powder, with care that no part is missed. The limb is then enclosed in plaster placed over the open wound, no dressing being applied, and the healing of the wound should proceed without gross infection.

Preoperative treatment is centered on impending shock, while anesthesia is obtained with the subcutaneous administration of morphine given one-quarter of an hour before operation, the intravenous injection of from 1.5 to 2 cc. of a 1 per cent solution of morphine, or, better, the Kirschner mixture (morphine hydrochloride, 0.25 gm.; scopolamine hydrochloride, 0.025 gm.; narcotine hydrochloride, 1.25 gm.; ephedrine hydrochloride, 0.25 gm.; and 0.75 per cent sodium chloride, 100 cc.) The latter mixture will give considerable analgesia and even sleep. If the operation requires the administration of a general anesthetic, this preliminary medication will aid in the induction and reduce the amount of general anesthetic required. Local anesthesia in cases of gunshot fractures of the thigh has a very limited application. It not only impedes the operative procedure, but, in open fractures, restricts the accuracy with which one can assess the extent of the damage and infection in the tissues. Ether, with the preliminary administration of morphine, provides an excellent and simple method of anesthesia and allows complete freedom for the operator, both in the extent of the operation and in the time required. Evipan given intravenously is an excellent anesthetic, but for prolonged use the services of a skilled anesthetist are required; this is true also when it is used for spinal anesthesia.

Cleansing of the wound consists in scrubbing the area with a soft brush. If necessary the wound is packed with dry sterile gauze and even temporarily closed with Michel clips. All wounds, even extensive in character, are given complete and thorough mechanical cleansing in this manner.

The excision of fresh wounds should be done under aseptic conditions and the operation carried out with strict precautions. The amount of tissue removed depends upon the surgical experience and judgment of the operator. In general, the skin wound is thoroughly excised along with all damaged subcutaneous tissue, while the deeper layers are removed with the deep fascia. Then all damaged and injured muscle tissue must be excised and in fractures, all loose fragments and blood clot are removed.

Drainage is considered so important that rules are given for its accomplishment. They are: (1) incision and approach to the site of fracture from the lateral aspect of the thigh through the vastus lateralis muscle; (2) funnel-like excision of this muscle with the apex at the seat of the fracture; and (3) suture, if necessary, of the skin edges to the deep fascia.

It is believed that the first task in modern warfare in the treatment of a wounded man is to prevent the loss of the man's life and limb by infection, and that this is achieved in the case of gunshot injuries of the thigh mainly by the operative procedures described, prolonged immobilization in plaster, and the use of local and oral sulfonamide preparations. That the procedures described are irreplaceable by any other method of therapy is attested by the high percentage (95 per cent) of patients whose lives and limbs are saved.

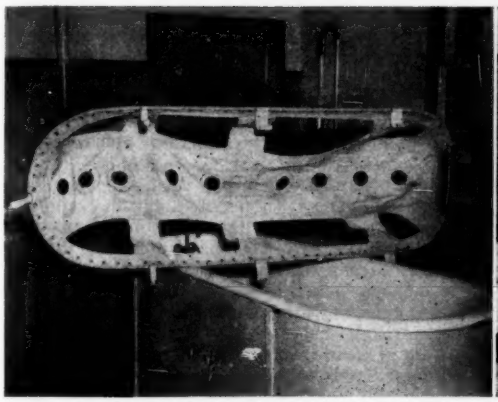


Fig. 1. Elevated six-foot bath tub; perforated canvas hammock bound with parachute cord to chrome molybdenum steel tubing, which conforms to shape of tub. Irrigation stand, for plasma administration—saline solution and intravenous anesthesia when indicated; Door leading to adjoining nurse's office, where additional sterile supplies are available; Spigot for continuous flow of water ranging in temperature from 85° to 100° F and Metal hooks which attach to side of tub.

Fig. 2. Débridement with attendant in rear ready to flush débrided areas with sterile normal saline solution, heated to 100° F. If possible, patient is covered with a cap and mask. On the left is a surgical cart with the required surgical instruments.

To the criticism that these procedures are prohibitively time-consuming, attention is called to the average time of thirty minutes required for each operation. STEPHEN A. ZIEMAN, M.D.

Weinshel, L. R.: The Treatment of Burns at an Army Air Forces Advanced Flying School. *Mil. Surgeon*, 1943, 93: 389.

The treatment of burns at an Army Air Force flying school or Air Base presents many difficult problems, especially since the type of burn is different from that usually met in civilian practice. The author has devised a special "burn room" which is kept as sterile as possible at all times so that when a burn case is brought into the hospital the room is available for instant use. This room contains a 6 or 7 ft. bath tub in which is suspended a perforated canvas hammock (Fig. 1), a surgical bed covered by a large adjustable heat cradle, and other necessary facilities. The suspension of the hammock and the multiple perforations in the canvas permit free circulation of water. The hammock can be easily removed to be washed and sterilized.

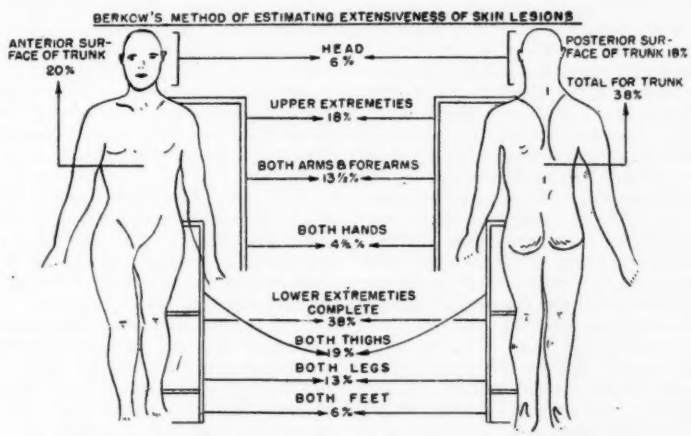

BERKOW'S METHOD OF ESTIMATING EXTENSIVENESS OF SKIN LESIONS
ANTERIOR SURFACE OF TRUNK 20%
HEAD 6%
POSTERIOR SURFACE OF TRUNK 18%
TOTAL FOR TRUNK 38%
UPPER EXTREMETIES 18%
BOTH ARMS & FOREARMS 13½%
BOTH HANDS 4½%
LOWER EXTREMETIES COMPLETE 38%
BOTH THIGHS 9%
BOTH LEGS 13%
BOTH FEET 6%

Fig. 3. Berkow's method of estimating the extensiveness of skin lesions. (*Army Med. Bull.*, 1942, No. 62.)

The procedure recommended by Allen and Koch, with some modifications, has been found to be the best for severe burns. The principal objectives are the after-treatment of shock, conversion of the contaminated wound into a clean one, application of an occlusive dressing that provides pressure, and provision for complete rest of the injured part. In determining the amount of plasma to be given, the percentage of the body surface involved by the burn, the hematocrit readings, and the plasma-protein determinations must be taken into consideration (Fig. 3).

At the same time that the plasma therapy is instituted the patient is immersed in the tub, resting on the hammock; a continuous flow of warm water allows a good cleansing of the area surrounding the burn with a minimum of contamination of the burned surface (Fig. 2). After débridement and irrigation with warm saline solution, the injured surface is covered with sterile, petrolatum-impregnated gauze strips. A compression bandage is then applied to prevent the exudation of plasma. Burns of the face, hands, and genitalia are treated with tincture gentian violet, which seems to reduce the incidence of infection and prevent deformities and contractures. CONRAD L. PIRANI, M.D.

Elkin, D. C., and Ward, W. C.: Gunshot Wounds of the Abdomen. *Ann. Surg.*, 1943, 118: 780.

This study is based on 238 patients who were admitted, in the period from January 1, 1937 to January 1, 1943, to the Surgical Service of the Emory University division of Grady Hospital, Atlanta, Georgia, with the provisional diagnosis of gunshot wound of the abdomen. All of the patients were negroes. Of the 238 patients included in this series, 29 had shotgun wounds and 209 had wounds produced by rifle or pistol.

Shotgun wounds. Of the 29 patients wounded with shotguns, 2 died before any operative procedure could be carried out. Nine patients were not operated upon because it was thought that very few, if any, of the bullets had entered the abdominal cavity and that the small perforations, should there be any, would seal spontaneously. In this group there was 1 death from pelvic abscess and peritonitis. Six of the 18 operative cases required resection of involved intestine; one of the patients survived, and in this instance an exteriorization and delayed anastomosis was done. The patients requiring resection were shot at close range with resulting extensive destruction of the abdominal wall, and often there was serious damage to the liver, kidney, pancreas, and large blood vessels. The mortality for the operated group was 55.5 per cent, and the mortality for the entire group was 44.8 per cent.

Pistol and rifle wounds. In the group of 209 patients who were shot with pistols or rifles, 15 died before any operative procedure could be carried out. These patients were admitted in severe shock and did not respond to intravenous fluids or transfusions. Thirteen patients were not operated upon because it was thought that the bullet did not enter the peritoneal cavity; 1 of these died, and autopsy revealed a large abscess in the right paracolic space. Of the 181 patients in this group who were operated upon, 84 died and 97 were discharged with an improved status, which gave a mortality rate in the operative group of 46.4 per cent. The total mortality was 47.8 per cent.

Injuries found at operation. In the group of 181 patients wounded with pistols and rifles who had exploratory celiotomies, the following organs were most commonly injured: small intestine, 37 cases with 14 deaths; small intestine and colon, 32 cases with 15 deaths; large intestine, 17 cases with 8 deaths; liver, 16 cases with 3 deaths; and stomach, 8 cases with 4 deaths.

Cause of death. Seventeen of the 238 patients died immediately after admission, and 1 died on the operating table. Shock and hemorrhage were striking findings. Forty-seven of the 94 postoperative deaths (50 per cent) occurred within forty-eight hours. These deaths are arbitrarily classified as due to shock and hemorrhage, pneumonia and peritonitis, or combinations of these. Severe blood loss seems to predispose to the development of pneumonia and peritonitis, hence there is much confusion of these factors as the actual cause of death in the early postoperative period. Twenty deaths occurred between the second and seventh postoperative days and, with 1 exception, all were due to pneumonia or peritonitis. The exception was in a case with evisceration on the fifth and death on the sixth postoperative day.

There were 27 late postoperative complications other than pneumonia or peritonitis with 15 deaths; the following were the most frequent: pelvic abscess, 8 cases with 5 deaths; postoperative obstruction requiring operation, 5 cases with 2 deaths; and postoperative evisceration, 5 cases with 1 death.

Chemotherapy. Thirty-three of the entire operative group of 199 patients were given sulfanilamide. Fourteen received the drug subcutaneously and 19 received it both subcutaneously and intraperitoneally; the number of deaths was 6 and 5, respectively, a mortality of 33 per cent. The drug seemed to be of considerable value in controlling the peritonitis. The average amount used intra-abdominally was 5 gm.

Diagnosis. In most instances, the diagnosis offers little difficulty. It is desirable to ascertain the time interval between injury and hospitalization and, if possible, the direction of line of fire. The back and sides, as well as the front of the abdomen should be inspected and palpated carefully. When there is no wound of exit, frequently the bullet may be felt immediately beneath the skin at some distance from the point of entrance. The point of entrance is examined in order to determine the direction of the bullet. Muscle rigidity may be absent or pronounced. Occasionally, when the internal injury is confined to the chest and associated with a hemothorax, there may be rigidity and tenderness of the

upper abdomen. The presence or absence of peristalsis cannot be relied upon.

Immediately upon admission to the hospital, a urine specimen should be collected and examined for blood. If no urine or only a few drops of blood are found on catheterization, it is probable that there has been a perforation of the bladder. Roentgenological examinations are helpful in many instances. They may indicate the position and probable course of the bullet, or they may reveal the presence of free air in the peritoneal cavity and thus influence the location of the incision. Some patients have practically no abdominal findings except the wound of entrance; therefore, it is best to explore the wound to determine the depth and direction of penetration, or to explore the abdominal cavity if it is at all possible that the bullet has entered it. To await signs of peritoneal irritation is not justifiable.

Preoperative preparation. Patients in shock are immediately placed in Trendelenberg position. Fluids are administered intravenously in all cases. Many of the patients will require blood or plasma. When urgency demands, group "O" blood may be given without crossmatching. Morphine sulfate is administered immediately unless the patient is in an alcoholic stupor. Warm blankets and hot water bottles are placed about the patient. A tube is inserted into the stomach through the nose, the gastric contents are aspirated, and the tube is left in place. If sufficient time elapses in the preoperative period, 500 cc. of 0.8 per cent (4 gm.) sulfanilamide are given subcutaneously as the initial dose. Mixed antianaerobic serum and 1,500 units of antitetanic serum are administered prophylactically to all patients. Attempts are made to move the patients to the operating room quickly and in the best possible condition.

Anesthesia. Nitrous-oxide-oxygen induction followed by ether is safest. Some method for aspirating the pharynx and trachea should be available.

Operative procedure. Wounds of entrance and exit are first excised, treated with sulfanilamide crystals, and packed.

Muscle-splitting rectus incisions have been used for all explorations. In most instances they are placed on the right side. Occasionally the left rectus incision, or a transverse incision in the flank will offer better exposure.

Immediately after the abdomen is opened the contents of the peritoneal cavity are aspirated. Vigorous bleeding, if present, is controlled. Usually, bleeding from the liver can be temporarily controlled with moist, hot packs, and bleeding from large mesenteric vessels can be controlled with digital compression of the root of the mesentery, until the site of bleeding is exposed and sutured. Autotransfusions may be employed under desperate circumstances.

Usually, the cecum is examined first; the small intestine is then inspected from the ileocecal junction to the ligament of Treitz, warm, moist packs being used to handle the intestine. Any perforations are repaired as they are found. Should a resection be necessary, clamps are placed on the open ends as a landmark, while the remainder of the small intestine is examined; thus the possibility of performing two anastomoses that could readily be converted into a single one without the loss of too large a segment is avoided.

The large intestine is explored next. Solid feces are removed with dry gauze sponges. The stomach and retroperitoneal structures are then carefully examined. Moderately sized retroperitoneal hematomas are left undisturbed unless they involve the kidneys, pancreas, or duodenum. Longer incisions and evisceration should be used if areas of injury cannot be exposed adequately. Minor lacerations of the kidney or spleen can usually be sutured; otherwise these organs should be removed. Most wounds of the liver are not bleeding at the time of exploration, but if active bleeding is present, sutures on a large, half-round, blunt needle can be used. In some instances it is necessary to use a gauze pack, which is brought out through the incision or a stab wound. Perforations of the diaphragm (on the left side) should always be closed to avoid the possibility of herniation.

All perforations of the intestines are freed of protruding mucosa and closed transversely with a running suture of fine chromic catgut, which includes all layers. This, in turn, is inverted with interrupted sutures of fine silk. Silk has been used on many occasions for the initial line of sutures and no apparent difficulty has been encountered.

After completion of the exploration and repair of injuries, the peritoneal cavity is again aspirated. No attempt should be made to irrigate it. Peritoneal drains are not indicated. From 4 to 6 gm. of sulfanilamide crystals are dusted into the abdomen. The peritoneum is closed with catgut. The remainder of the wound, including all layers except the peritoneum, is closed with through-and-through sutures of silver wire or silkworm gut. About 1 gm. of sulfanilamide is placed in the incision.

Postoperative treatment. The patients are placed in Fowler's position after reaction, unless shock is evident. Constant suction with an indwelling tube is applied to the stomach and from 4,000 to 5,000 cc. of fluid are administered daily. Sulfanilamide is given subcutaneously, 150 cc. of 0.8 per cent solution (1.2 gm.) every six hours. Frequent blood sulfanilamide determinations should be made. The appearance of jaundice and anemia are indications for discontinuation of the drug. In the absence of toxic effects, administration is continued subcutaneously until sulfadiazine can be taken by mouth. This usually takes four or five days in uncomplicated cases. When peristalsis is normal, the abdomen soft, and flatus is being passed by rectum, gastric suction can be discontinued and water given by mouth. During the immediate postoperative period, oxygen with 5 per cent carbon dioxide is administered every four hours to prevent pulmonary atelectasis. Obstruction and paralytic ileus occurring in the early postoperative

period respond well to the use of the Miller-Abbott tube. Feeding is begun on the sixth or seventh day. Wound infection, pelvic abscess, and subphrenic suppuration should be watched for carefully.

ERNEST E. ARNHEIM, M.D

Osborn, G. R.: Findings in 262 Fatal Accidents. *Lancet*, 1943, 245: 277.

Diagnostic errors are more common in the everyday accident case than in any other branch of medicine and surgery. To insure accuracy in diagnosis and treatment, the establishment of "combined clinics" is advisable. By this means the surgeon in charge will, as a routine, see new patients with specialist surgeons and physicians, radiologists, and pathologists. Diagnostic errors are not infrequent. Of the cases treated for head injury about 10 per cent were pseudo-head-injuries. Overlooked gas gangrene was the next most common error.

The type of accident has a general bearing on the lesion to be expected; the greater the force, the higher is the probability of lesions of the body viscera. There is no substitute for examination in diagnosis. In the brain, lungs, and heart, injuries from direct violence and contre-coup are found. The lungs and heart also show lesions due to "pincer" forces in V spaces and the heart, in addition, may show a type of lesion which depends on the association of its rhythmic contraction with the injuring force. The most common complicating lesion of all these injuries is acute pulmonary edema. This, it is suggested, is merely the dramatic manifestation of peripheral circulatory failure or shock. Its presence calls for judgment in giving transfusions. Pulmonary embolism indicates bad management in most cases.

WALTER H. NADLER, M.D.

Johnston, R.: The Battle of the Mareth Line: An Analysis of Casualties by Types and Causes. *J. R. Army M. Corps*, 1943, 81: 176.

There were 732 of 850 casualties evacuated to the Casualty Clearing Station area from March 20 to 23, 1943. Of these patients, 269 (37 per cent) were able to walk and 463 (63 per cent) were not. The majority showed multiple injuries, which included the following conditions:

	Actual no. of cases	Per cent of casualties
Penetrating abdominal wounds	14	1.9
Penetrating chest wounds	31	4.2
Penetrating head wounds	8	1.1
Compound fractures—upper limbs (upper arms, 32; forearm 11)	43	5.8
Compound fractures—lower limbs (thigh, 13; leg, 34)	47	6.4

The number of necessarily "immediate" operations performed by the field surgical unit were 36 (5 per cent of 732 casualties). There were 56 patients (7.6 per cent of 732) requiring blood transfusions; 190 pints of plasma were used, i.e., 3½ pints per patient. Twenty patients (2.7 per cent of 732) died in or on the way to the field ambulance.

The classification of wounds by causes is as follows:

	Actual no. of cases	Per cent of casualties
Shell wounds	297	40.6
Mine wounds	35	4.8
Gunshot wounds	186	25.4
Mortar bomb wounds	45	6.2
Bomb wounds (principally grenades)	31	4.2
Bayonet wound	1	.1
Unclassified wounds	29	3.9
All other causes of evacuation	108	14.8

The author believes that the best estimation of casualties during a frontal attack on a strongly defended "line" is just under 20 per cent of the attacking troops.

LEROY J. KLEINSASSER, M.D.

Eccles, C. E., and Perkins, H. N.: The Medical Services in an Armoured Division. *J. R. Army M. Corps*, 1943, 81: 155.

The medical unit of an armored division should be a very mobile and adaptable organization. In all cases it was found advisable to split up the authorized Regimental Medical Equipment into two portions: the essential battle equipment, to accompany the medical officer in action, and the heavier and less essential equipment sent to the A.1 Echelon together with the ambulance car from the Light Field Ambulance Unit in the rear.

The Medical Officer of a Tank Regiment must adopt a standard position on the ground during the battle period, i.e., in the vicinity of Regimental Headquarters, where he is in communication with all squadrons via the regimental forward control. It is a definite and unalterable rule that casualties shall be brought to him and he will not proceed into the throes of the battle to effect treatment, for in so doing he may not be available for more urgent and serious cases elsewhere.

It is essential for the Medical Officer to be provided with an armored vehicle for his own personal use in battle. Usually the Daimler Scout car has been found the most suitable for this purpose.

The Medical Officer of the Motor Battalion will usually be located behind his unit and in the vicinity of Tactical Brigade Headquarters with which he maintains close liaison. At his disposal is a small pool of three or four ambulance cars which can immediately be made available to any unit in the brigade.

The emphasis in the Infantry Battalions of Motored or Lorried Infantry Brigades is placed on the speed with which such a formation can move forward and evacuate casualties in an attack.

The medical problem encountered in the Armored Car Regiment is one of distance. Patrols may be working on reconnaissance or maintaining contact with the enemy over a very considerable front and over a depth of many miles. Individual cars may be compelled to render first aid to a wounded member of the crew and also carry him for long periods.

A Light Field Ambulance unit is organized on the basis to include a Headquarters, which forms the

Main Dressing Station, and four or six sections. The Main Dressing Station is a shelter which provides cover for patients. Its size in general is 40 ft. square; it is covered with a tarpaulin sheet. In order to retain mobility, patients are not held in these shelters but evacuated as soon as possible. Should the unit receive orders to move while patients remain, a section is left to evacuate them and must rejoin the unit at the earliest opportunity.

Where no Field Surgical Unit is attached, urgent emergency surgery is carried out in the Main Dressing Station of the Light Field Ambulance Unit.

When a Surgical Unit is attached, all the surgery within a Division is concentrated in this one Main Dressing Station, which is invariably located three miles behind the Rear Divisional Headquarters.

Evacuation of casualties is done with a pool of cars, three of which will be with the forward car post and six with the Brigade Section.

The use of returning empty transport planes in evacuation of the sick and wounded from the forward areas to a general hospital has been of tremendous advantage in the early and definitive treatment of all types of cases.

The Divisional Medical Administration is located at the Rear Divisional Headquarters with the other Heads of Services, and controls the working of the medical service from this point. Communication with the forward area is established principally through liaison officers who maintain contact between sections of the Light Field Ambulance Unit, the Medical Division Section, and the A.D.M.S.

STEPHEN A. ZIEMAN, M.D.

Logie, N. J.: Surgical Gleanings from the Middle East. *Lancet*, Lond., 1943, 245: 658.

This article consists of surgical "bits and pieces" learned and relearned at base and forward areas in the Middle East. The author believes that fluid and food are two great therapeutic agents the value of which is not sufficiently recognized. It is particularly important to provide adequate proteins.

Because of the extensive use of antipersonnel mines and bombs, multiple peppering, penetrating, and perforating wounds of the lower limbs were common. In such cases the skin was cleansed in the usual manner and the wound rapidly explored with a pair of forceps. The use of rubber drainage material proved unsatisfactory and therefore the wounds were well opened and dressed with soft paraffin gauze. Early skin grafting with "pinch grafts" in the presence of skin defects is recommended and sulfanilamide should be given locally before the grafting.

One should never set out to remove foreign bodies, per se, without roentgen localization. Foreign bodies should not be removed just because they happen to be present. Removal is indicated if the foreign body is superficial and easily located or if it produces symptoms. It is well to place the limb in the position it held when injured so that the tract can be more easily reconstructed, and it is well to remember that the position of the foreign body is often betrayed by an area of tenderness and/or swelling of undamaged skin away from the site of wounding. Wounds should not be packed, as the plug then acts as a cork by sealing up the discharge and giving rise to abscess formation, or it permits the collection of exudate and leads to cellulitis. Paraffin gauze was used so that the granulation tissue would not grow into the interstices of the gauze.

Clean through-and-through bullet wounds should not be explored unless there is rapid swelling. This must then be relieved and the bleeding point ligated. One should be cautious of an "abscess" in the popliteal fossa, groin, antecubital fossa, or axilla when associated with an "old" wound as the "abscess" may turn out to be a traumatic aneurysm. No war wounds should be closed in forward areas with the exception of wounds of the head, small sucking chest wounds, and deliberate abdominal incisions.

A firm dressing nearly always suffices to control bleeding; packing is seldom necessary and a tourniquet is rarely required. A tourniquet should never be applied directly to a limb; the skin should always be protected. Ligation of both the vein and the injured artery is favored by the author.

The prevention of gas gangrene requires adequate initial surgery. Gas-gangrene serum should be given as well as chemotherapy. When gas gangrene is established, excision of the affected muscles, or amputation, sulfathiazole, and massive doses of polyvalent gas-gangrene serum are required. The skin should be saved as this is a disease of muscle.

The author states that a finite amputation of a mangled limb should not be done as he believes all amputations become septic. It is important to avoid the pure guillotine amputation; flaps should be fashioned. Adhesive traction may be necessary to produce adequate flaps. A plaster-cap molded over the end of the stump is a great aid.

One of the greatest advantages of plaster is that it prevents unnecessary inspection. The casts should all be split before evacuation and no windows cut. No skin-tight dressing should be present. It is important that adequate information be printed on the plaster with indelible pencil. Pain is a prime indication for removal of the plaster. It is important to fix joints in the best functional position and digits must be kept free and mobile. Fractures should be well stabilized and plaster is the best means of stabilization but it should be used in conjunction with the Thomas splint.

The prognosis of head wounds is not so gloomy as was thought. These cases travel well in the early stages, but not so well later or after operation. Wounds of the face should never be sutured under tension, and it is best if they are left open, with at most one or two narrow-bit approximating sutures to hold any flap in position. The treatment of chest wounds in forward areas should be conservative. Sucking chest wounds and pressure phenomena are the greatest problems requiring immediate

attention. Unless of minor degree, chest cases should not be evacuated until fit. Wounds of the abdomen should be operated upon within, at most, twenty-four hours. After operation, these cases should be held for the critical first seven days if at all possible. It is important to evaluate solitary wounds of the buttock, perineum, or lower chest carefully for they may well cause extensive intraperitoneal damage. The treatment of wounds of the colon should be limited chiefly to exteriorization and colostomy. Wounds of the small bowel should be sutured in preference to being resected. At Tobruk there were 8 survivors among 10 consecutive wounded who were operated upon for bowel injury. Suprapubic cystostomy should be done in all cases with paraplegia as a result of spinal-cord injuries. The advantage of this is that it makes nursing easy during transit. It is advised that this be done in all cases of urethral damage.

The true value of chemotherapy in the prophylaxis of wound infection has not been determined. Sulfanilamide should be sprinkled and not packed in a wound, and should not be placed near nerve tissue.

A shocked patient who otherwise appears fit for surgery and does not respond to adequate resuscitative measures in one or two hours, or who has a relapse, should be examined to find the cause of the lack of response. Transfusion should be early and adequate. Pentothal is an ideal anesthetic for the forward area provided it is used intelligently.

LEROY J. KLEINSASSER, M.D.

Stalker, L. K.: Surgical Problems in the Tropics. *Am. J. Surg.*, 1943, 62: 201.

All persons who have been in a highly malarial area during the season of incidence are potentially infected with malaria whether they have shown overt symptoms or not. Symptoms or blood findings confirmatory of malaria were present in 70 per cent of postoperative patients and in the remainder the diagnosis of dengue was made. Therefore, all surgical patients are now given quinine (gr. 10) three times daily or atabrine (gr. 1½) four times daily. The incidence of malaria in these cases is now negligible.

Whenever a blood transfusion is given there is some risk of transmitting infections from donor to recipient and it is frequently impossible to obtain donors who have not been exposed to the risk of malaria infection. In giving prophylactic antimalarial therapy, one should not overlook the fact that donors who have latent or suppressive malaria may, after a short interval, precipitate an attack of the disease.

Patients with malaria may have abdominal symptoms which may very easily be confused with the picture of true acute cholecystitis, appendicitis, perforating peptic ulcer, or intestinal obstruction.

In the discussion of deficiency states, the fact is brought out that the healing of wounds, burns, infections, and tropical ulcers was definitely slower in those patients who showed evidence of malnutrition.

Because of their volatility certain of the general anesthetic agents cannot be administered satisfactorily by the open method. In the author's opinion the most ideal single anesthetic agent available is pentothal sodium which is to be administered intravenously. Spinal anesthesia was used second in frequency.

JOSEPH GASTER, M.D.

ANTISEPTIC SURGERY; TREATMENT OF WOUNDS AND INFECTIONS

National Research Council: Medical Progress; The Treatment of Thermal Burns. *N. England J. M.*, 1943, 229: 817.

The treatment of thermal burns is one of the most acute problems of war surgery; it has been the subject of many publications, and many discussions have been devoted to it. The abundance of details and the frequently contradictory character of the evidence, however, sometimes make it difficult to see the main trends of the development. For this reason, the present general outline sketched on a historical background has been prepared.

PREWAR PERIOD

Before World War I the treatment of burns was local and very often purely empirical.

In the course of World War I and its aftermath, increasing attention was paid to the phenomenon of shock. Burns presented themselves more clearly as a thermal trauma that was often followed by shock, was easily open to infection, and might lead to disfiguring scars and contractures. The classification of burns into three degrees, apart from expressing the severity of the burn, also made it possible to distinguish between burns in which the skin would regenerate and those in which skin grafting was required. Since, however, the severity of a burn and the extent of the subsequent shock were even more dependent on the extent of the burned area, an estimate of the latter was of prime importance. Such an estimate was provided by the Berkow method in 1924.

It was the problem of shock that in 1925 led Davidson to the introduction of the tannic-acid treatment of burns. Davidson concluded that the constitutional reaction is probably due to absorption of some toxic substances from the burned area. Such absorption, he thought, might be prevented, and he chose tannic acid to precipitate the poisonous materials in burned tissue. Although the precipitation of toxic substances was the key point for Davidson, he believed that the treatment had several additional advantages, one of which was the prevention of loss of body fluid.

Underhill, and later Blalock and others, elaborated a theory of burn shock as a result of injury to the capillaries, anhydremia, fluid shift, and anoxia. It was, moreover, shown that the fluid shifting toward the burned area had the character of blood plasma, and that the circulating blood was relatively rich in blood corpuscles but poor in plasma proteins.

Aldrich, in 1933, denied the existence of nonbacterial toxemia in burns; in his opinion the toxemia was due to sepsis. Aldrich used triple dye, that is, a mixture of brilliant green and acriviolet (acriflavine and crystal violet).

In 1935, Bettman proposed the tannic acid-silver-nitrate method in order to obviate the slowness of tanning and the rigidity of the eschar produced by tannic acid.

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In spite of criticism, tannic acid, possibly in combination with silver nitrate or antiseptics, remained the local medication of choice for the hospital treatment of burns. Chemotherapy in the form of sulfonamide drugs, used orally or locally, had come into use to obviate the danger of sepsis that tannic acid alone might not always prevent.

PERIOD FROM THE OUTBREAK OF THE WAR UNTIL PEARL HARBOR

At the outbreak of the war, the treatment of burns was relatively uniform. In first-aid treatment, picric acid was given preference in Great Britain as well as in this country, although in the United States tannic acid was given almost equal place. Due stress was placed on combating shock by keeping the patient warm and providing him with fluids.

In the hospital, treatment with tannic acid alone or in combination with silver nitrate or antiseptics predominated. The procedure recommended by McClure was as follows:

Measures to control shock came first. The patient was given sedatives, heat externally, fluids (5 per cent dextrose and a physiological solution of sodium chloride), and transfusions of blood plasma. The local treatment consisted in removing the clothing, superficial débridement, and the application of a 5 per cent freshly prepared solution of tannic acid with an atomizer or powder spray. Collections of pus under the tan were liberated, skin grafting was employed early, and blood transfusions were given in late stages of secondary anemia. Strict aseptic precautions were observed during the surgical procedures, since the burned area should be regarded as a large open surgical wound.

The work of Elkinton and his associates, in 1940, made it clear that plasma transfusions had to be given in the very early period after injury. Estimates of the amount of plasma required, based on the extent of the burn, on hematocrit and hemoglobin readings and on calculations of the plasma deficit, assumed an important place in subsequent outlines of the treatment of burns. The quest for plasma and serum substitutes, on the other hand, did not meet with unequivocal success. It was realized that the administration of saline solutions was dangerous since it tended to increase the edema unless vomiting had led to a serious loss of chlorides. Following this work, no completely new aspects in the general treatment of shock have been introduced during the war, as in the case of the local treatment.

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Besides the use of saline baths, silver nitrate, triple dye, gentian violet, and other drugs already mentioned, there emerged a host of different therapeutic procedures. The use of trypsin to clear up the burned surface was envisaged, euglamide and the closed-plaster treatment were recommended, and Bunyan, followed by other workers, suggested the envelope method with irrigations. By the middle of 1941, the local treatment of burns had become confused, and anything might be good if, in addition, sulfonamide drugs were prescribed.

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The local application of sulfonamides, which at the outbreak of the war appeared to have great promise, also had its ups and downs. Omitted by some and cautiously used over small areas, usually in combination with coagulants, by others, it was employed by still others as local treatment. Best known among the latter methods was the one announced in August, 1941, by Pickrell, who sprayed the burned area with 3 per cent sulfadiazine in 8 per cent triethanolamine. Among the other drugs applied locally were sulfathiazole ointment, plastic films of polyvinyl alcohol containing sulfonamide drugs, and hydrated films containing 10 per cent sulfanilamide and buffer, with and without quantities of azochloramid.

THE PERIOD AFTER PEARL HARBOR

The disaster at Pearl Harbor on December 7, 1941 resulted in a great number of burns, and the treatment given shows some decisive differences as compared with the British procedure in 1940. Whereas in Great Britain shock had been mainly combated by keeping the patients warm and giving them large quantities of fluids orally, at Pearl Harbor, in addition, blood plasma, supplemented by glucose and saline solution, was used in most cases. The local medication varied considerably; the treatment was divided between tannic acid, sulfonamides, gentian violet, and boric-acid wet dressings.

In spite of all the criticism and the many alternative remedies suggested, coagulation with tannic acid still predominated in the first half of 1942. It had generally been recognized by this time that tannic acid should not be used on critical areas. The state of affairs is approximately characterized by the recommendations of the National Research Council formulated in January, 1942. Regarding first-aid treatment it is here stated: "All burned surfaces except the face, hands and genitalia should be liberally coated with a water soluble jelly containing 10 per cent tannic acid and 5 per cent sulfadiazine. Burns of the face, hands and genitalia should be covered with a water-soluble emulsion containing 5 per cent of sulfadiazine." The definitive treatment of other areas envisaged tannic acid, 10 per cent, and silver nitrate, 10 per cent. Sulfadiazine was given orally as a routine measure.

The recommendations of the research councils of the United States and Canada mention a point that indicates further development. For burns on the hands, they suggest a firm-pressure bandage. This was an early recognition of a method that was soon to have a much wider application. The burned area had to be examined, cleansed, and covered under strictly aseptic safeguards. The covering had to be nonirritant and had to protect the surface and prevent loss of fluid. From January 1, 1939 on, the mortality rate at the Cook County Hospital in Chicago was considerably reduced by thorough cleansing and the placing of a pressure dressing over the vaseline gauze. This treatment, first detailed for burns of the hand, became more widely known through an article by Allen and Koch concerning the treatment of patients with severe burns.

In April, 1941, Buis and Hartman found that shock with plasma loss and hemoconcentration occurs in experimental burns and produces acute congestion of the tissues, especially of the liver. They suggested that anoxia resulting from the shock, plasma loss, hemoconcentration, and acute congestion was a contributing cause of liver necrosis. But a few months later Wells, Humphrey, and Coll, gave a different interpretation of the liver damage. They claimed that the central necrosis of the liver was the result of treatment with tannic-acid jelly or tannic-acid and silver-nitrate solutions. The dangers of the tannic-acid treatment, in turn, enhanced the advantages of the Koch method.

Studies by Siler and Reid presented experimental evidence suggesting that primary pressure dressings may reduce the loss of plasma at the site of, and into the surrounding tissues of, burned areas. On the other hand, the practical possibilities of the pressure method, which presupposes the strictest aseptic technique, were regarded with some skepticism by the armed forces. At the present moment, it cannot be said that any single method has been accepted to the exclusion of all others. The local treatment chosen depends on the site of the burn as well as on its degree. The pressure dressing is now recommended by the National Research Council.

ERNEST E. ARNHEIM, M.D.

Clowes, G. H. A., Jr., Lund, C. C., and Levenson, S. M.: The Surface Treatment of Burns. *Ann. Surg.*, 1943, 118: 761.

During the period from August, 1942, to March, 1943, 150 cases of burns (65 from the Cocoanut Grove disaster) were studied at the Boston City Hospital for the purpose of comparing results from surface applications of ointment gauze dressings, from tannic-acid-silver-nitrate, and from triple dye. The burns were of the second (a part of the epithelium destroyed) and third (the whole epithelium destroyed) degrees, the classification being made at a time after the injury when an accurate estimate as to depth and of the areas involved in each depth could be made. The percentages of body areas involved were calculated by the use of Berkow's formula. Morphine and plasma therapy, if needed, were given before surface treatment was started.

The tannic-acid-silver-nitrate treatment was used only on burns of the body, legs, and arms. After the removal of loose debris and washing (occasionally under anesthesia), freshly dissolved 10 per cent tannic-acid solution in water was applied. Then the remainder of this solution was added to an equal amount of 10 per cent silver-nitrate solution which made a solution of 5 per cent of each. This was applied at once and every half hour for four applications. After the fifth application of the tanning solution, a dry, firm, rather thin, moderately elastic eschar was formed. A cradle producing moderate heating with electric lights was used to promote the

drying. If the eschar remained intact and clean it was allowed to remain until it came away spontaneously. This occurred only in a few second-degree burns. In all third-degree cases signs of softening with infection under the eschar appeared in from four to eight days. The eschar was excised over such areas and secondary treatment initiated.

Triple dye (a water solution containing gentian violet, methyl green and acriflavine) was used on burns of all parts of the body including hands and face after a moderate amount of cleaning. During the period of application the patient was protected from contact with bed clothing by a cradle with lights, and the solution was brushed on with a sponge every one-half to one hour. An eschar was formed much more slowly than with tannic-acid-silver-nitrate, and applications were continued up to twenty-four hours in most cases and up to forty-eight hours in some. These eschars were much more sensitive to moisture than tannic eschars. In a few cases triple-dye eschars were retained for several weeks, and softened areas were repaired by redyeing.

Autoclaved strips of fine-mesh gauze impregnated with vaseline and of wide-mesh scrim impregnated with boric-acid ointment were used for the treatment of many areas of burns of the hands, face, feet, or genitalia of all patients otherwise treated with tannic-acid-silver-nitrate and of some patients treated with triple dye. Such ointment dressings were also applied to the bodies, arms, and legs as the only treatment of other patients. Burns of the face in some cases were treated by the application of vaseline or boric-acid ointment without gauze. Preliminary cleansing was carried out in some cases, but later it was given up entirely.

Vaseline gauze, boric-ointment gauze, and saline, boric-acid or weak Dakin's solution were the chief applications used in secondary treatment. If good progress was being made with ointment dressings these were replaced at intervals of five to seven days until healing or the necessity for grafting was demonstrated. When the time for a grafting approached, a change to frequent moist dressings was made. Tannic-acid or triple-dye eschars on deep burns frequently had to be removed at the end of the first week because of underlying infection. All the patients with second-degree burns suffered very little pain at any time following the first dressing, but most of the patients with third-degree burns suffered greatly and became extremely sensitive to very slight trauma. In 8 cases Bunyan envelopes were used as a means of supplying irrigation. Splints were used early and freely in burns of the forearm and hand and occasionally for burns of the legs.

Concerning the relation of hemoconcentration to surface treatment, none of the treatments used to control surface leakage controlled the subcutaneous loss of plasma which may be very large in amount. Subcutaneous edema was most marked in the face and disappeared within ten days without pressure.

There were 75 patients having only second-degree burns, varying in area from 1 to 20 per cent of the body surface. The surface treatments were as follows: vaseline, 59 cases; triple dye on some areas and vaseline on others, 8; tannic-acid-silver-nitrate, 7; triple dye, 1 case. About half of the whole group had temperatures of 101°F., or more, some time in the first three days, and the other half had normal temperatures at all times. Sulfadiazine was given orally in one-half of the cases for prophylaxis. Two slight infections (3 per cent) occurred in vaseline-treated cases (1 of which had sulfadiazine for prophylaxis), which indicated that infection is not an important problem in cases with second-degree burn only.

Skin healing of second-degree burns of the face was faster (average eleven days) and of the back slower (average twenty-three days) than that of all the other parts of the body (average eighteen days). The healing time of second-degree burns of all areas except the back was shorter with ointment or triple dye than with tannic-acid-silver-nitrate. In second-degree burns of the back the healing time in those treated with ointment was shorter than that of the other two methods. Areas of pure second-degree burn heal no more rapidly than the areas of second-degree burn associated with areas of third-degree burn. Areas of second-degree burn heal as rapidly when extensive as when small, within the limit of size observed (20 per cent of body area). The range of time of healing varies directly with the depth of the second-degree burn.

Fifty-seven of the 75 patients with mixed second- and third-degree burns had 9 per cent or less of body area involved in the third-degree burn. There were 19 instances of clinical infection in this group, but none was serious. The 18 patients with 10 per cent or more of surface area in third-degree burns all had important infections which occurred irrespective of the surface treatment employed and in spite of adequate sulfadiazine treatment. In the management of third-degree burns, in addition to the prophylactic administration of sulfadiazine, dressings were infrequently changed, attendants were masked, and an aseptic technique was used.

In addition to the problem of infection, many of the patients with 10 per cent or more of surface area involved in third-degree burns showed loss of weight, anemia, and critical metabolic disturbances, including azotemia, hypoproteinemia, and abnormally high losses of nitrogen. High protein and high vitamin diets, iron, and frequent blood transfusions were used to combat these complications.

There were 2 early deaths, one from shock at twenty-two hours following inadequate plasma administration, and the other at five days in a patient with thrombocytopenic purpura, anemia, edema, and azotemia as complications. An analysis of the remaining 16 patients with third degree burns in 10 per cent of the surface area of their bodies revealed 8 deaths occurring after the second week. All 5 patients with third-degree burns covering 10 or 15 per cent of their body area survived, while only 3 of 11 patients with 20 per cent, or larger areas, of the surface area in third-degree burns survived. This

indicates that there is a critical area of third-degree burns involved at about 20 per cent of the body surface area. The statistics suggest, but do not prove, that vaselined-gauze and triple-dye treatment were safer for large third-degree burns than treatment with tannic-acid-silver-nitrate.

In an analysis of the healing of third-degree wounds, the times of disappearance of gross slough and first skin graft were considered as the best criteria. Areas treated with vaselined gauze became free of slough on the average of twenty-seven days and were grafted earlier, on the average of thirty-six days, than areas treated with the other two methods. Small third-degree burns became free of slough and were grafted earlier than large ones. Deep burns became free of slough after a longer interval than burns that barely removed all epithelial elements. This was true particularly if fascia or tendons were involved, as in some of the patients with burned hands. Location of the burned area was not as important as in second-degree burns, although the skin of the back was usually slow to separate even when the underlying fascia was not involved.

Thiersch grafts were used in all but 2 instances in which grafts were applied. Sixty-two per cent of the first Thiersch grafts on all of the cases grafted were fairly successful, 14 per cent were partially successful, and 24 per cent failed to take.

ERNEST E. ARNHEIM, M.D.

Bodenham, D. C.: The Problem of Fractures with Associated Burn Injuries: Principles of Treatment. *Proc. R. Soc. M., Lond.*, 1943, 36: 657.

In the R.A.F., this combination of major injuries, fractures with burns, is due almost exclusively to flying accidents. The initial mortality is high, but once such cases reach a base hospital the recovery rate is approximately 80 per cent.

The best results are obtained for the transport of patients and first-aid treatment by covering of the burned parts simply with sterile dressings. Clothes should not be removed—they have been sterilized by heat. Immobilization of the fracture is of the utmost importance; the femur is the commonest serious problem and should be placed in a Thomas splint with traction by means of a well padded clove hitch or boot clip.

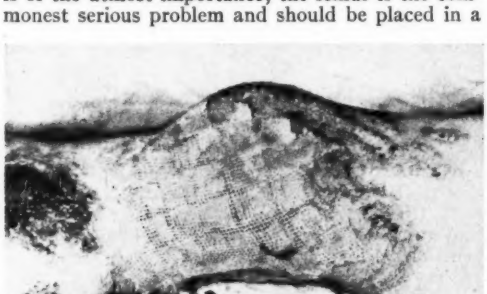

Fig. 1. The sheet is anchored with sutures at each corner and covered with a pressure dressing of gauze, absorbent wool, and elastic crepe bandage.

The shock in the combination of injuries under discussion presents earlier and lasts longer than when the injuries occur alone. Early and apparently successful resuscitation may be misleading; therefore continued observation is necessary for a period of forty-eight hours.

Reduction by manipulation of the fractured limbs which are burned, particularly the thigh, is often a procedure associated with shock. In such severely injured cases it has been the practice to be satisfied with one manipulation and approximate reduction until, with improvement in the general condition, it is possible, without risk, to improve the position.

A blood transfusion while the patient is under the anesthetic is then a valuable measure. Anemia is common to all serious injuries, but is a particular problem in these complicated cases. Its treatment includes a maximum diet with iron, ascorbic acid, and vitamin B complex in the form of yeast or marmite. Delayed healing of a burn is observed if the hemoglobin remains below 65 per cent.

The principal cause of death in extensive burns after the fourth day is widespread surface infection. This can be reduced by (a) early covering of the burned surfaces with sterile dressings; (b) early transport to the specialist hospital; and (c) adequate cleansing and dressing of the burned surfaces.

Thorough cleansing of the fresh burn can be carried out painlessly without general anesthesia after a dose of morphia (gr. ¼ to ⅓) has been administered. Deep burns are quite insensitive, because of destruction of the nerve endings. All freshly burned surfaces must be considered contaminated and so treated. Following the cleansing, the part is lightly "frosted" with sulfonamide powder and dressed with tulle gras, gauze, and bandage. Firm pressure, as advocated by Koch in America and others, will in conjunction with elevation of the injured part reduce the fluid loss and prevent excessive swelling. In cases of extensive burns only a part of the total area should be exposed at a time; then with the utmost gentleness the least effect on the general condition is produced.

Manipulation of a fractured limb which is also burned must be postponed until the burn has received this treatment. If the decision is made to plaster the limb then the dressings should be thin. A heavily padded plaster defeats its own purpose. In the case of the femur the choice is traction with removable dressings for local therapy.

At every change of burn or wound dressing a swab should be taken for culture and the appropriate local treatment given. The following methods are successful in this unit:

Penicillin is beyond doubt the most effective agent yet produced for this purpose. It is at least 50 times more effective than sulfonamide. It is quite nontoxic. This is amply proved in 100 cases treated in this Unit.

The less soluble sulfathiazole is safer than sulfanilamide for local application to extensive raw areas.

It is considered justifiable to give severe cases of burns a course of a sulfonamide if infection of the injuries has begun to produce deterioration of the general condition.

Infection	Treatment
Streptococcus haemolyticus	Sulfanilamide powder applied as a light frosting, every twenty-four or forty-eight hours
Sulfonamide-resistant hemolytic streptococcus	Penicillin in lanette wax and vaseline emulsion cream—strength 100 units per gram applied every twenty-four or forty-eight hours
Staphyloccus aureus	Penicillin as above
Bacillus pyocyaneus	Sulfacetamide powder

The keeping of a fluid-balance chart during the seven days following the accident is essential. An intake of 120 oz. per day should be aimed at with a minimum urine output of 60 oz.

The aim is the grafting of third-degree burns as soon as possible. By the fourth week the sloughs should have separated and granulation should be fit to receive the grafts. Second-degree burns unless heavily infected are never a problem at this stage—they are always healed.

There is no question that the healing of epithelium is slower under plaster in the presence of infection. Successful grafting under plaster in the absence of infection is a valuable measure. In the presence of infection local treatment through a window in the plaster for at least a week is probably necessary, and then curettage of the granulations prior to grafting will give good results.

The multiple or pinch-type graft is to be preferred. A method which has been used is to cut a sheet graft and divide this into small pieces. If the graft is laid on tulle gras, this is easily handled—the small squares of graft (⅛ in. square) are stuck to it, and laid on a large piece of tulle gras the size of the wound. The whole is then applied to the granulating surface. Such a technique offers a high rate of success.

If the grafts are applied at distances of one-fifth inch apart, the whole area will be healed within ten days under normal conditions.

ROBERT P. MONTGOMERY, M.D.

Pick, F. and Barton, D.: Burns Treated with Viacutan: with Special Reference to the Face and Hands. *Lancet*, Lond., 1943, 245: 408.

The main disadvantages of tannic acid in the treatment of burns are its contractile effect and its toxicity. However, coagulation should be considered the treatment of choice, especially under wartime conditions.

The authors have experimented with "viacutan," which is silver dinaphthylmethane disulfonate and is used as a 1 per cent solution adjusted to a *PH* of 4.5. This substance seems to meet all the requisites for the ideal treatment of burns. Its antibacterial and pharmacological properties were tested both in experimental animals and in laboratory tests. Clinical observations were made in more than 80 cases, including many burns of the hands and face.

The important advantages of viacutan for the local treatment of burns are: its easy application, the rapid relief of pain, the slight degree of edema and immobilization of the affected part after application and therefore the complete safety of its use for the face and hands, the quick healing with no scarring or disability, and its remarkable bactericidal and bacteriostatic properties. CONRAD L. PIRANI, M.D.

Bettley, F. R.: Desert Sore: A Preliminary Study. *J. R. Army M. Corps*, 1943, 81: 107.

Desert sore, as observed in army units in the Western Desert, has importance not so much because of the severity of the average case but because of the great number of cases which arise. Most cases occur in the summer months and show an epidemic tendency; it is usual for many cases to occur in the same unit.

Desert sores occur principally on the dorsal aspects of the hands and forearms and on the elbows. The early lesion is a flaccid intradermal vesicle or bulla 2 to 5 mm. across, containing thin seropus and surrounded by a narrow margin of erythema. Within a day or two the lesion has grown to 1 to 3 cm. in diameter and soon ruptures in the center. Pus tends to form small pockets beneath the undermined edge. The sore is very superficial and with weak antiseptic dressings heals in from seven to ten days. True ulceration of the skin may occur but should be considered as a complication. The condition described by Manson-Bahr under the same name is probably not the one under consideration.

Bacterial studies of a limited number of cases of desert sore lead to the conclusion that it is identical with facial impetigo. Treatment used in civilian practice is usually successful.

GEORGE A. COLLETT, M.D.

De Waal, H. L.: Wound Infection. A Preliminary Note on a Combined Clinical and Bacteriological Investigation of 708 Wounds. *Edinburgh M. J.*, 1943, 50: 577.

A total of 708 wounds were subjected to repeated bacteriological examinations from the date of hospitalization to the time of complete healing and discharge, in order to determine their bacteriological status and to ascertain the effect of various types of treatment.

The wounds were classified according to their nature and severity: (1) deep penetrating wounds, such as bullet wounds, compound fractures, and stab wounds; (2) deep open lacerations with free drainage and much tissue destruction from shrapnel or machinery; (3) superficial wounds; and (4) burns—these were classified according to whether or not the true skin was destroyed.

The following substances were selected for study in the local treatment of wounds: sulfanilamide and sulfapyridine powders, sulphacetamide (albucid paste), acriflavine, gentian violet, brilliant green, eusol, zinc peroxide, saline solution (iso- and hypertonic), and the coagulants, tannic acid, and silver nitrate plus gentian violet. A few cases were also treated by direct application of a crude penicillin preparation. Bacteriological specimens were taken as soon as possible after injury, and thereafter at frequent intervals—daily, when possible, in the early stages—until healing was complete or the patients were discharged from the hospital.

Specimens were taken in all cases by swabbing the area and the adjacent skin prior to, after, and during all manipulations, surgery, and change of dressings. By microscopic examination and cultivation tests on various media under aerobic and anaerobic conditions, the bacteriological histories of cases could be followed from day to day, while immediate effects of any antiseptic could be judged and compared with its delaying action.

Of all the wounds admitted to the hospital, 18.9 per cent contained the staphylococcus pyogenes, and 13.1 per cent contained the hemolytic streptococcus; other pathogens were found in much lower percentage. The most frequent organisms present at this stage, as well as during hospital treatment, belonged to the group of nonpathogenic staphylococci and to the diphtheroid group. Although 27 of 708 wounds contained the clostridium welchii and other clostridia were found in 31, only 3 patients developed symptoms of gas gangrene.

The number of organisms present in wounds on admission to the hospital was found to be directly related to the time that had elapsed after the injury: up to six hours the number was small, but after eight hours it was much greater. This emphasizes the need for treating wounds during the first fourto six hours after injury.

According to the anatomical site of the wound, it was found that hemolytic streptococcal infection was more frequent in wounds of the head, face, neck, hand, and forearm than of other regions. The nonhemolytic streptococcus was commonly found in wounds of the head, face and neck, and of the groin, perineum, and thigh. In nearly half of the cases of injury of the groin, perineum, thigh, buttock, and lower abdomen, the coliform bacillus was present, and in 13 per cent the clostridium welchii was present. The proteus and the bacillus pyocyaneus were also relatively frequent in wounds of this region as compared to wounds in other parts.

Infections were more frequent in wounds which had been "cleansed" and dressed than in those which had only been dressed. It was shown that when first-aid "cleansing" of wounds was done, more than twice as many infections by hemolytic streptococci occurred than when the wound was simply dressed without an attempt to "cleanse" it. Wounds which had been covered at an early stage with a sterile dressing arrived in the hospital in the least infected state. Moreover, it was demonstrated that 86 per cent of all wounds and 67 per cent of the burns became infected during treatment in the hospital. The organisms were mostly of low pathogenicity, although of the 708 cases studied, 146 became infected with the hemolytic streptococcus and 231 with the staphylococcus pyogenes. Hemolytic streptococci accounted for most of the severe complications, and in many of these complications blood culture was positive. However, the staphylococcus and the Gram-negative bacillus, especially the proteus and the bacillus pyocyaneus, were apparently responsible for the greatest retardation of healing.

Possible sources of these infections pointed to inspection and examination by unmasked attendants, without strict aseptic precautions. A mode of infection not commonly suspected is that which occurs when air currents created by the movement of patients in bed pass from below the bedclothes over the wounds. Consequently, during dressing all movement of the patient should be discouraged. Slipped dressings accounted for contamination, while motile organisms like the proteus and the bacillus pyocyaneus were shown to be able to pass through a ½ in. thickness of serum-soaked plaster.

The bacteria infecting wounds in the hospital were, in order of frequency, the staphylococcus, proteus, staphylococcus pyogenes, bacillus pyocyaneus, bacillus coli, nonhemolytic streptococcus, hemolytic streptococcus, clostridium welchii, and anaerobic streptococcus.

Of 38 wounds treated in closed plaster, 34 became infected.

If the rate of healing is the criterion of efficiency in the treatment of wounds and burns, all the substances used, except acriflavine and gentian violet, yielded almost equally good results. If freedom from infection is the criterion, (excluding penicillin) the flavines are the best treatment. It was found that repeated applications of acriflavine (1:1,000) soaks rendered many wounds sterile in from three to five days. However, after four or five days, substitution of another antiseptic substance for the flavine should be done, and with a relatively clean wound, the sulfonamides are best suited for this purpose.

Second-degree burns healed well under most forms of treatment, except when gentian violet or acriflavine was used on repeated wet dressings. The form of treatment least painful was tanning with silver-nitrate-tannic-acid, with or without gentian violet, carried out under anesthesia. In deep burns, in which the true skin was destroyed, the coagulants were disappointing, and the best results were obtained with penicillin, brilliant green, eusol, the sulfonamides, and the flavines.

The careful excision of wounds was shown to be of paramount importance in reducing subsequent infection.

Although the experience of the author with the application of penicillin to wounds and burns has not been sufficient to enable him to appraise the bacteriostatic effects of this substance, of all the antiseptics

used to combat wound infection, this substance appears to hold the greatest promise.

STEPHEN A. ZIEMAN, M.D.

Jones, C. M., Bartlett, M. K., Ryan, A. E., and Drummey, G. D.: The Effect of Sulfanilamide Powder on the Healing of Sterile and Infected Wounds. *N. England J. M.*, 1943, 229: 642.

This is a further study of wound healing in guinea pigs maintained at varying levels of vitamin C intake. The study was also conducted to determine whether sulfanilamide powder placed in wounds produces any deleterious effect on the healing process.

The animals were divided into three main groups: group A guinea pigs were maintained on a scorbutic diet throughout the period of study; group B pigs were on the same diet plus 1.5 mgm. of ascorbic acid daily; and group C pigs were on the same diet plus 15 mgm. of ascorbic acid daily. The animals were maintained on these diets for a preliminary period of two weeks and then an incision of the abdominal wall was made in all of them with the following complementary procedures:

Subgroup 1 (control group): no other procedure.

Subgroup 2: sulfanilamide powder was inserted in the wound.

Subgroup 3: infection was induced at a distance from the operative wound (subcutaneous inoculation of 1 cc. of culture of the beta-hemolytic streptococcus. The inoculation invariably resulted in a walled-off abscess).

Subgroup 4: infection was induced at a distance from the wound and sulfanilamide powder was inserted in the wound.

Subgroup 5: infection was induced in the operative wound.

Subgroup 6: infection was induced in the operative wound and sulfanilamide powder was inserted.

A strip of tissue adjacent to the wound was excised for control ascorbic-acid assay. The tensile strength was measured by the application of a direct pull on the healing scar.

The studies confirm the authors' previous findings that the ascorbic-acid content of the healing wounds in guinea pigs varied with the ascorbic-acid intake. Such variations were in no way influenced by the presence of local or distant infection or by the introduction of sulfanilamide into the operative wounds.

The tensile strength of the healing wounds varied with the intake of ascorbic acid and the resulting ascorbic-acid content of the scar.

The use of sulfanilamide in the healing wound did not reduce the tensile strength of the scar.

The presence of local infection distant from the healing scar did not alter its ascorbic-acid content or tensile strength. However, in numerous cases local wound sepsis reduced the tensile strength and interfered with normal healing. This was particularly marked in scorbutic animals but also occurred when local sulfanilamide therapy was not completely effective.

Certain of the results obtained in these studies suggest that maximal saturation of the tissues with ascorbic acid aids in providing optimal tissue resistance to infection.

JOSEPH GASTER, M.D.

Barnett, H. L., Perley, A. M., Forbes, G. B., and Goldring, D.: The Use of Sulfapyrazine in Infants and Children. *Am. J. M. Sc.*, 1943, 206: 599.

The authors present a study of the absorption and distribution of sulfapyrazine (2—sulfanilamidopyrazine) in a group of infants and children with various infections, along with observations on the therapeutic value and the toxic effects of this drug.

Observations were made on 258 cases with various types of infection, including 22 cases of meningococcus meningitis.

The drug was administered orally in a dosage of 0.1 gm. per kgm. of body weight as an initial dose, followed by 0.2 gm. per kgm. per twenty-four hours in 4 divided doses. Subcutaneous administration of sodium sulfapyrazine was carried out in selected cases with a 0.5 or 1.0 per cent solution in Ringer's or lactate—Ringer's solution.

Blood levels of the free drug during oral administration of sulfapyrazine in the dosages used are definitely lower than those obtained with equivalent dosages of sulfadiazine and possibly somewhat lower than those obtained with sulfathiazole. The lower blood levels occur particularly in patients under two years of age. The average of all the determinations for the entire group was 4.3 mgm. per 100 cc. Concentrations of free sulfapyrazine in the blood change so little from the fourth to sixth hour (average fall 11 per cent) after the oral administration of the drug that quite uniform levels can be maintained by giving the drug at six-hour intervals. The fact that high blood levels are maintained with comparable amounts of the drug given parenterally indicates that the low levels after oral administration are not due to rapid excretion.

By giving a 0.5 per cent solution of the sodium salt subcutaneously, the difficulties of intravenous administration in small infants are avoided. Very high blood levels can be attained within a period of one to three hours after beginning the administration, and at the same time the volume of fluid in which the drug is dissolved assures a good fluid intake. High concentrations can be maintained by repeated subcutaneous injections every eight to twelve hours.

An average of 64.4 per cent of the amount of sulfapyrazine in the plasma (76.2 per cent of that in the whole blood) was found in the spinal fluid. This is a similar percentage of drug to that observed with sulfapyridine and sulfadiazine therapy.

A sufficient number of patients was treated and studied to warrant the opinion that with the dosages of sulfapyrazine and sodium sulfapyrazine employed, the effectiveness equals that of the other sulfonamide drugs.

The authors believe that a sulfonamide drug as effective as the ones now commonly used but one

which produces fewer renal complications would be most desirable. It appears from the series that sulfapyrazine produces fewer severe renal complications than the sulfonamide drugs now commonly used, with the exception of sulfanilamide.

Toxic effects attributable to the sulfonamide drugs occurred no more and possibly less frequently in this series of patients treated with sulfapyrazine than would have been expected in a series similarly treated with any other of the sulfonamide drugs.

DWIGHT E. CLARK, M.D.

Reid, M. R., and Altemeier, W. A.: Peroxide Ointments. *Ann. Surg.*, 1943, 118: 741.

The value of peroxide therapy has been established, principally by Meleney, in the care of wounds or other lesions, caused or secondarily infected by anaerobic streptococci, microaerophilous hemolytic and nonhemolytic streptococci, the clostridium tetani, anaerobes of the gas-gangrene group, actinomyces, and certain spirochaetes.

The chief disadvantage of hydrogen peroxide is the rapidity with which all of its oxygen is dissipated on a wound surface, which necessitates frequent or continuous irrigation with this solution. Of all peroxides for local use, zinc peroxide is the most effective. The difficulties of preparation and of the application of zinc peroxide powder suspended in water have limited the use of this substance to well equipped hospitals. To overcome these disadvantages, the authors developed an active and stable zinc-peroxide ointment.

In a search for a suitable ointment base, the authors studied different combinations of "carbowax" and the various glycols. A satisfactory nontoxic zinc-peroxide ointment with the following formula was developed:

"Carbowax"—1540.....120 gm.
Nonethylene glycol-polyethylene glycol—400
..... 80 cc.

This is mixed thoroughly in a boiling water bath until dissolved. To the cooling solution is added 10 per cent of finely milled, activated zinc peroxide and 0.2 per cent of cetyl pyridinium chloride, and the mixture is stirred continually until a smooth homogeneous ointment is formed. Zinc peroxide can be activated by heating to 140° C. for four hours in a dry oven, although a less effective ointment can be prepared from the inactivated material.

The technique employed in dressing a lesion consists in preliminary cleansing of the surface with hydrogen peroxide and saline solution, followed by a liberal application of the ointment. Since the zinc peroxide is gradually decomposed by wound secretions, it is not necessary to add water, or to cover the ointment with gauze or cotton pads soaked in water, although the authors have usually done so. A layer of vaseline gauze is then used to cover the area and seal in the evolved oxygen and the wound secretions. The interval between dressings is from twenty-four to seventy-two hours. With this technique, the authors have noticed rapid control of infection and disappearance of foul odors with no delay in wound healing.

ERNEST E. ARNHEIM, M.D.

ANESTHESIA

Young, D.: The Effects of Novocain Injections on Simulated Visceral Pain. *Ann. Int. M.*, 1943, 19: 749.

Twenty-six patients with spondylitis and simulated visceral pain, in whom the symptomatology could be reproduced by pressure on the muscles lateral to one or more vertebra and by torsion or hyperextension of the spine at the same level, were subjected to novocain injection into the tender paravertebral muscles, from 8 to 10 cc. of 2 per cent novocain being the amount injected. All of the patients were relieved of their pain. Many who were followed-up for more than a year after the injection had no recurrence. Several had a recurrence of symptoms from six to eight months later, at which time the procedure was repeated and prompt relief was obtained. In several cases in which normal saline solution was injected instead of novocain the pain was relieved for from twelve to twenty-four hours but thereafter it returned with its original intensity and distribution.

The mechanism of the radicular syndrome was discussed. The joint involvement was considered the primary cause, and the muscular and ligamentous tenderness a secondary factor—either spasm or a localized "myositis" or "fibrositis." More difficult to explain, however, was the prolonged period of complete freedom from pain which followed the injections. It seems to be the result of deep novocainization due to the initial anesthetic action plus the expanding action of the solution itself.

Among the cases treated, two groups of patients with simulated visceral pain were encountered—those with and those without visceral disease. In both groups the results were uniformly good.

MARY KARP, M.D.

Betcher, A. M.: Pentothal Sodium: A Survey of Its Field of Usefulness in a Military Hospital. *War Med.*, Chic., 1943, 4: 425.

This survey reviews the practicability of pentothal sodium as a safe anesthetic agent for administration in a military hospital. The pharmacology of the agent was discussed in detail, as were the methods of preparation and administration. The agent was given in a 3 per cent solution by the multiple-syringe method, 30-cc. syringes being used because this size syringe was provided in the Army supplies.

For procedures of long duration an infusion set was connected and the pentothal was injected into the rubber tubing close to the site of the infusion needle. Morphine sulfate and atropine sulfate were given an hour and one-half preoperatively for premedication, or morphine sulfate was administered intravenously on the patient's arrival in the oper-

ating pavilion. The smallest amount of pentothal used was 0.28 gm., which was given in one minute (the shortest period of use) for closed reduction of a dislocated shoulder. The largest amount of pentothal sodium used in a procedure of short duration was 1.7 gm. in ten minutes. The procedures which composed the greater portion of the series reported were in the field of minor surgery including fractures.

There was no contraindication to the use of pentothal sodium in patients receiving sulfanilamide or its related compounds. A delay in the onset of shock was produced when this agent was used instead of ether anesthesia. There was no contraindication to the intravenous administration of the drug unless the vital capacity was diminished or there was pulmonary obstruction or irritation due to war gases. The administration of the drug was considered a safe procedure in experienced hands. Ether was the preferred anesthetic for administration by men of the training corps.

MARY KARP, M.D.

Hingson, R. A., and Edwards, W. B.: Continuous Caudal Analgesia. *J. Am. M. Ass.*, 1943, 123: 538.

The authors report the first 10,000 cases of continuous caudal analgesia and present in detail the results of this method in their first 1,000 cases. In their own series, 91.3 per cent of the patients were managed throughout labor and delivery without resort to any other form of analgesia or anesthesia. Supplementary anesthesia was found necessary only when difficulty was experienced in inserting the needle, when general anesthesia of the mother was necessary, when monstrosities or abnormal babies were expected, as previously determined with x-rays, and when reaction of the patient occurred to the regional drug.

The average length of analgesia for primiparas was six and one-half hours, and the average dosage of metycaine was 4.5 gm.; the average time of analgesia for multiparas was two hours and twenty minutes, and the average dosage of metycaine was 2 gm.

Three important methods of administration of continuous caudal analgesia have been reported in the literature: the malleable needle technique, the ureteral-catheter technique, and the continuous drip caudal technique with a closed gravity apparatus. The first method was used by the authors in the greatest proportion of their cases and in over 6,000 cases reported in the literature. Thirty cubic centimeters of 1.5 per cent metycaine have been used as an initial dose and supplementary doses reinjected at intervals varying from forty to ninety minutes. The authors preferred a 1.5 per cent metycaine solution in an isotonic solution of sodium chloride, or an isotonic solution of three chlorides, to other of the cocaine derivatives. They found that the blood-pressure fall was in direct proportion to the anesthetic efficiency of the drug and was apparently due to the pharmacological effect of splanchnic vasomotor block and peripheral vasomotor block of the lower extremity. Less than 8 per cent of the parturients had a blood-pressure drop of 20 mgm. of mercury when the level of anesthesia was not permitted to rise above the umbilicus and the fluid intake of the patient was kept normal.

The anatomical basis for this procedure was carefully discussed along with the anomalies that might be experienced.

Indications for the use of this method were enumerated and included premature babies, heart disease, eclampsia, and cesarean section. Some complications associated with this method were:

1. Broken needles—to minimize this possibility it was advocated that the same needle be used for not more than 5 administrations.

2. Infection—one death was reported in the authors' series from a peridural infection. There were 3 minor infections of the sacral and gluteal area with cellulitis and abscess formations. Among the other 10,000 cases reported there were 3 instances of peridural infection. All cleared up under sulfanilamide therapy.

3. Unilateral anesthesia—this occurred in 5 per cent of the patients who were kept on their side.

4. Bladder dysfunction—40 patients in the authors' series had to be catheterized more than twice during the post-partum period.

5. Backache—in about 5 per cent of the cases.

6. Vomiting—in 20 per cent of the cases.

7. Drop in the blood pressure—in from 20 to 27 per cent of cases. Ephedrine 5 mgm., or 10 mm. of 1:1000 epinephrine were used to combat this drop.

Contraindications to this method were few. They included infection over the proposed site of injection, anatomical anomalies, low-lying dura, gross deformities of the spinal column, sensitivity to cocaine derivatives, advanced anemia, psychically unsuited cases, placenta previa, and obese patients.

The incidence of postoperative deliveries was increased with this method, and posterior positions were more numerous (about 8 per cent) because of relaxation of the levator muscles with failure of the fetus to rotate. The incidence of transverse arrest in midpelvis was slightly increased. All types of operative obstetrics were facilitated because of increased relaxation. Babies were delivered in good condition. The incidence of fetal motility and morbidity was decreased. The first stage and the third stage of labor were definitely shortened. The terminal part of the second stage was greatly prolonged unless outlet forceps was used. MARY KARP, M.D.

PHYSICOCHEMICAL METHODS IN SURGERY

ROENTGENOLOGY

Robbins, L. L.: The Roentgenological Diagnosis of Parasternal Omental Hernia. *Radiology*, 1943, 41: 378.

There is little information in the literature concerning the roentgen diagnosis of parasternal hernia. In those instances in which intestines are present, the demonstration of loculated gas obviously gives a good indication as to the nature of the lesion, but if the hernia contains only omental tissue, the diagnosis may be very difficult.

The author, in reporting 3 cases of parasternal omental hernia observed at the Massachusetts General Hospital, Boston, describes a roentgen sign which greatly facilitates the diagnosis. This sign is the upward displacement of the colon and stomach in the presence of a mass in the right anterior cardiophrenic angle. A preliminary roentgen study of the chest, as a rule, reveals a shadow of soft tissue density at the right cardiophrenic angle which on lateral view lies close to the anterior chest wall. The first impression is that of a mediastinal tumor, but a supplementary barium enema will show that the colon appears as an inverted V, with the point toward the mass. A barium meal will show the antrum of the stomach also drawn upward and forward in the direction of the mass.

The 3 cases are briefly described, and the sign is illustrated with roentgenograms. The correct diagnosis is important because of the surgical possibilities.

T. LEUCUTIA, M.D.

Freid, J. R., and Goldberg, H.: Frequency, Clinical Course, and Treatment of Metastases from Cancer of the Breast. *Am. J. Roentg.*, 1943, 50: 499.

In a series of 641 cases of breast carcinomas, 160 (25 per cent) revealed local recurrence after radical mastectomy. Cutaneous metastasis may occur by direct extension, lymphatic emboli or permeation, and by hematogenous emboli. Nodules may be single or multiple (encuirasse type). The encuirasse involvement is difficult to treat. Small, isolated skin nodules may be treated by local excision or irradiation. The latter is preferred. When surgery is done there is danger of cutting through cancer-bearing tissues and vessels.

Axillary involvement meant that (1) the original surgery was not complete, or (2) it was surgically impossible to remove the entire lesion. Treatment of this area is difficult and results are not encouraging. The axilla is irradiated by means of the divided dose technique with multiple fields.

Supraclavicular extension may be seen in the late stages of the disease. Pertinent clinical findings are: (1) Horner's syndrome, (2) involvement of the brachial nerve, and (3) pain. When supraclavicular nodes are seen in the early stages of the disease, irradiation should be given vigorously.

In 1931, a series of 168 cases of breast cancer with bone involvement was studied. Eighty-one cases (48 per cent) had skeletal metastasis, revealed either by the x-rays or by autopsy. Only 14 cases showed involvement of a single bone. Most of the skeletal changes were multiple. The skeleton was involved primarily in 82 per cent of the cases. In 9 per cent (3 cases) the primary metastasis was in the lung, and in the other 9 per cent skin metastasis was the first complication. Eighty per cent of the cases which exhibited primary skeletal metastasis within a short time revealed involvement in other parts of the body.

Pain and tenderness were the chief clinical complaints in 61 cases (75 per cent). Pathological fractures were present in 21 cases (26 per cent). Palliative irradiation was given to the skeleton when the metastases were numerous. In slow-growing metastasis and in the apparent absence of additional metastasis, irradiation was intensive and the results good. In the latter cases, roentgenograms taken before and after therapy revealed a filling-in of new bone in the involved areas; clinical complaints subsided; and the extremity performed its normal function. Many pathological fractures showed good results after irradiation.

Intrathoracic metastasis was present in 45 per cent of a series of 168 cases and in 89 per cent of a series of 131 autopsies. In only 1 case was the heart alone involved. Clinical symptomatology was as follows: cough in 30 per cent, dyspnea in 22 per cent, and pain in 13 per cent. Irradiation was not successful. At most, in the large single metastasis, it was palliative. Results of irradiation therapy, except for isolated cases, were not encouraging. This might have been due in part to the fact that in most cases the lungs and pleura were involved as well as the mediastinal lymph nodes.

Ascites was present in 12 cases (9 per cent), and the symptomatology caused by visceral metastasis varied. Pertinent symptoms were: back pain, gastrointestinal pain, weakness, loss of weight, and cachexia. The results of radiation therapy for abdominal metastasis were very poor.

Of the 89 cases (24 per cent) with clinical involvement of the central nervous system, 40 were subjected to autopsy. The brain and skull were most frequently involved (73 and 45 cases, respectively). Spinal-cord metastasis was present in 28 cases (7.5 per cent). Clinical symptomatology in metastasis of the central nervous system consisted of signs of increased intracranial pressure: local neurological signs of cerebral, cerebellar, and brain-stem involvement with and without increased intracranial pressure. Palliative therapy was attempted in cases with metastasis of the central nervous system.

In view of the experience of many writers, the authors are of the opinion that all cases should be given roentgen castration. Many writers state that the chances of metastatic spread to the skeleton and

chest are lessened by roentgen castration. In some cases they have observed that the patient's life has been prolonged by the regression of the metastasis.

MAURICE D. SACHS, M.D.

Pendergrass, E. P., and White, G.: Pulmonary Metastasis and Pneumonitis Following Radiation Therapy for Cancer of the Breast. *Am. J. Roentg.*, 1943, 50: 491.

Fifty-four cases of breast carcinoma with pulmonary metastases were studied in an effort to determine the effect of irradiation on the type of metastasis, and whether infiltrative pulmonary metastasis could be differentiated from chronic irradiation pneumonitis.

The three essential types of pulmonary metastases studied were: nodular, infiltrative, and pleural. The nodular type was readily identified by circular areas of increased densities. The size and number were variable. The infiltrative type was characterized by a linear increase in density extending (fan-shaped) from the hilum into the lung periphery. The dome of the affected leaf of the diaphragm might be elevated, its movement restricted, and the intercostal spaces narrowed. Pleural metastases were seen as a nodular density or thickened pleura. Pleural fluid at times obscured the pleural nodules. In order to demonstrate the nodules in such cases it was necessary to remove some fluid and substitute air into the pleural cavity.

The authors observed that the nodular type of metastases was quite frequent when little or no irradiation was given to the lungs. Infiltrative metastases were frequent with increasing amounts of irradiation. Pleural metastases were equally divided in all degrees of irradiation. Five cases showed a mixed type of metastases.

The histopathology of the breast tumor had no relationship to the type of pulmonary metastasis. Twenty patients in the series were thought to have the infiltrative type of metastases. The authors experienced difficulty in distinguishing radiation pneumonitis from linear infiltrative metastases and are of the opinion that the term "pleuropneumonitis" is a misnomer and that the term "radiation pneumonitis" is more accurate in describing the pathology. In 3 cases with pneumonitis following irradiation, an emphysematous bleb was seen on the involved side. (The bleb is a secondary lung change occurring in patients several years after treatment.) Attention was also directed to partial atelectasis and emphysema in irradiation pneumonitis. One patient developed a pneumothorax following rupture of one of the blebs. Emphysematous blebs have not been seen in cases with infiltrative metastases and this may be a differential factor in distinguishing radiation pneumonitis from infiltrative metastasis.

Chest roentgenograms taken before and at varying intervals during and after treatment provide an excellent method of identifying radiation pneumonitis from infiltrative metastasis. Early pulmonary irradiation changes are diffuse. In the chronic form the diffuse haze is replaced by coarser and less homogeneous densities. Infiltrative metastases begin in the hilum and gradually spread in a fan shape into the lung periphery. Clinical findings in radiation pneumonitis and infiltrative metastasis were cough, dyspnea, chest pain, and weakness.

MAURICE D. SACHS, M.D.

Smithers, D. W.: The X-ray Treatment of Carcinoma of the Esophagus. *Brit. J. Radiol.*, 1943, 16: 317.

A brief discussion on the treatment of carcinoma of the esophagus by various methods is followed by a detailed consideration of cases in which an attempt was made to apply Mayneord's work on the three-dimensional distribution of radiation and energy absorption. It seemed to offer the best opportunity for placing a high dose of radiation in the volume of tissue where it was needed, and nowhere else. Technical details of the method are discussed from both theoretical and practical standpoints. Charts of the volume distribution of the radiation in an average patient are included.

Fifty-one patients first seen in 1937, 1938, and 1939, form the basis of this study. Thirty-two of them completed their treatment and these are tabulated as to the period of survival. Three of these patients are alive and symptom-free at six years and four months, five years and one month, and four years and nine months after treatment. Of the 44 patients treated 30 had marked relief of symptoms and 11 were quite symptom-free for varying periods of time. Of the 32 patients who completed treatment, 14 lived for one year or more and 5, for more than two years.

The results obtained indicate that the relief of symptoms alone has been very well worth while and has been achieved with little discomfort to the patients. It is at least possible to say that useful palliation can be obtained in many cases and that an occasional cure can be expected as the result of carefully applied x-ray treatment.

A. HARTUNG, M.D.

MISCELLANEOUS

CLINICAL ENTITIES—GENERAL PHYSIOLOGICAL CONDITIONS

Frankau, I. M.: Acceleration of Muscular Effort by Nicotinamide. *Brit. M. J.*, 1943, 2: 601.

Increased resistance to fatigue or increased muscular ability, as a result of the addition of certain vitamins, especially B_1, to the diet, has been reported by a number of observers. The present series of experiments tends to show that the addition of certain vitamins to the diet of healthy young men generally results in varying degrees of increased efficiency in carrying out a fairly severe test, involving both physical efficiency and co-ordination.

Experiments were carried out on 20 subjects, 10 of whom received on three successive days vitamin tablets containing 8,000 i.u. of vitamin A, 1,200 i.u. of vitamin D, 2 mgm. of thiamine, 4 mgm. of riboflavin, 100 mgm. of ascorbic acid, and 40 mgm. of nicotinamide. The remaining 10 subjects acted as controls. Vitamin tablets given on 4 successive days were used in experiments carried out on two larger groups of subjects, one of which acted as a control. These tablets contained 5 mgm. of aneurin, 5 mgm. of riboflavin, 100 mgm. of ascorbic acid, and 50 mgm. of nicotinamide.

In these experiments, it was shown that the addition of nicotinamide alone, or of nicotinamide and certain other vitamins, to the regular diet of young men resulted in increased physical efficiency and co-ordination. Continued physical stress may necessitate increase of the dose. SAMUEL KAHN, M.D.

DiPalma, J. R.: The Circulation in the Skin in the Shock Syndrome: Comparison of Simple Prognostic Features of Clinical Value. *J. Am. M. Ass.*, 1943, 123: 684.

The author's purpose was to establish a physiological and clinical basis for the evaluation of certain features of shock states and to show that a few simple tests of the circulation in the skin are of diagnostic and prognostic importance in various types of shock syndrome which are commonly encountered. Most observers dismiss the skin with the brief statement that it is pale, sometimes ashen in color, cold, and sweaty in shock. The result of shock is slowing-up of the peripheral blood flow. This is demonstrated in the skin by coldness of the extremities, cyanosis of the nail beds, and, sometimes, actual stagnation of the blood in the small blood vessels. While slowing of the peripheral blood can exist without the patient's being in shock (as for example in cardiac failure, myxedema, peripheral vascular disease, or in debility), it must be remembered that the shock syndrome cannot exist in the presence of an adequate circulation.

Forty-nine cases of surgical and medical shock of various degrees of severity were closely followed. Eleven additional cases of suspected shock which later proved to have different disease syndromes were also studied. Twenty-five cases are reported as being representative and are presented in a table. Clinically detectable skin circulatory changes were noted on admission of the patients and were compared with objective tests of skin circulatory changes. The clinically detectable changes were in the skin temperature and color, and in the response to the blanching and tache tests. The objective tests of skin circulatory changes were the reactive hyperemia ring test and the capillary sensitivity coefficient test.

It has been shown that the disappearance or clearing time of a standardized reactive hyperemia response produced by local ischemia of the skin is related to the rate of blood flow. This is determined by the application of a weighted rubber ring (100 gm. per sq. cm.) to the skin of the flexor surface of the forearm. This pressure is maintained and the time required to produce ischemia with a response of hyperemic rings is noted, as well as the length of time required for the hyperemic rings to fade completely, and the latter is known as the clearing time. Determination of the capillary sensitivity is complex. A strength-duration or excitation curve was determined by using a mechanical device capable of varying both the speed and the intensity of application of a stroker along the skin.

In an evaluation of these tests clinically, the author believes that the estimation of the amount of blood present in the skin by means of the skin blanching test is particularly valuable. A mere observation that the skin is pale is inadequate. The changes in skin temperature and skin color seemed to indicate little. He also believes that the tache response should be determined in all cases. The reactive hyperemia ring test proved more valuable than the others. It permitted objective determination of alterations in the blood flow in the small blood vessels of the skin of the forearm. This is superior to the determinations of the blood pressure which admittedly is a late index of the peripheral vascular situation. It is also noted by means of the capillary sensitivity coefficient test that there is an increase in small-vessel sensitivity in deep shock.

LEROY J. KLEINSASSER, M.D.

Bass, A. D., Frost, L. H., and Salter, W. T.: 2-Anilinoethanol, an Industrial Hazard: Production of Methemoglobinemia. *J. Am. M. Ass.*, 1943, 123: 761.

An oil mixture containing 2-anilinoethanol (improperly named "phenyl ethanolamine") caused cyanosis in 2 factory employees who were using it. This substance likewise produced cyanosis in dogs, but not in rabbits and mice. As established in dogs, the presence of methemoglobinemia is the cause of the cyanosis.

Because the problem of toxicity is likely to arise repeatedly as new industrial uses are found for the many related chemical substances which will be available, this example has been cited. The hazard of such intoxication of human beings might be mitigated if special care were taken that similar substances are named as aniline derivatives. At least a cautionary label should be applied to warn industrial safety committees of the danger.

J. M. MORA, M.D.

Romano, J., Engel, G. L., Webb, J. P., Ferris, E. B., Ryder, H. W., and Blankenhorn, M. A.: Syncopal Reactions during Simulated Exposure to High Altitude in the Decompression Chamber. *War Med.*, Chic., 1943, 4: 475.

The authors analyzed the syncopal reactions occurring during 754 individual exposures of 51 subjects to a simulated altitude of 35,000 feet (10,500 meters). The not infrequent occurrence of syncopal reactions during simulated exposures to high altitude in the decompression chamber raises important questions in regard to the selection of flying personnel. During the 754 exposures, syncopal reactions occurred 91 times in 37 subjects. There are three major physical changes that result from reduction of atmospheric pressure to the equivalent of 35,000 feet which may affect the human organism. The first is the reduction of oxygen tension, which leads to anoxia. This was controlled in these experiments. The second change is the increase in the volume of gas-containing structures resulting from the decrease in external pressure. The third change has to do with the decrease in solubility of gaseous nitrogen in body fluids and tissues at diminished pressure, which leads to supersaturation and bubble formation and results eventually in decompression sickness. This may be manifested by: (1) the bends, (2) the chokes, (3) cutaneous lesions, and (4) subcutaneous and deep crepitus.

There were two main types of syncope: (a) the vasopressor type (74 cases), characterized by rapid onset, progressive course, and symptoms of weakness, nausea, sweating, pallor, and hypotension, which were related to posture; and (b) the nondepressor type (11 cases), characterized by a recurrent and fluctuating course, flushing, and absence of signs of circulatory collapse.

Syncopal reactions occurred most often in the presence of multiple symptoms of decompression sickness. Chokes were the most frequent precipitating factor. Bends alone were considered to be the immediate precipitating factor of 31 syncopal reactions. Of these reactions, 30 conformed to the vasodepressor pattern, while in the remaining case the only symptoms noted were hot and cold sensations, which on other occasions had been precursors of syncopal reaction in this particular subject.

Chokes alone were considered to be the precipitating factor in 30 cases, which may be subdivided as follows: (1) vasodepressor reactions, and (2) nondepressor reactions. All instances of nondepressor type followed chokes. "Prechokes," i.e., substernal or pharyngeal burning without cough or restriction of respiratory movements, was considered the provoking factor of 6 syncopal reactions.

Bends and chokes were the provoking factors of 11 reactions. Abdominal distension was the provoking factor of 4 syncopal reactions. Other factors were anoxia, venipuncture and arterial puncture, inhalation of amyl nitrite, anxiety, hyperventilation, scotomas, and vertigo.

Inherent susceptibility to syncope may be a possible predisposing factor in syncopal experiences at altitudes. The significance of inherent susceptibility may be assayed by (1) an analysis of a previous history of syncope, (2) an analysis of syncopal experiences on first flights, and (3) a consideration of those subjects who had syncopal reactions in a high proportion of their flights. It was found that it was not possible to predict syncopal reactions during flight from the occurrence of earlier reactions. It was also apparent that there was no significant difference in the tendency toward repeated syncopal experiences or in the intensity of the precipitating symptoms. There was no correlation between a history of syncope and the occurrence of flight syncope. The tendency to repeated flight syncope could not be predicted from the first flight experience. Frequent syncopal reactions occurred in subjects susceptible to severe decompression sickness; they were complications of decompression sickness rather than indications of susceptibility to syncope.

Syncopal reactions occurring with mild decompression sickness may be regarded as having a large psychological component resulting from lack of familiarity with the flight experience itself. Thus, indoctrination procedures may tend to avoid syncopal reactions.

In the great majority of cases of syncopal reaction during flight the symptoms were promptly relieved by decompression. With the more severe syncopal reactions, however, persistence of the symptoms was not unusual. The most striking feature of the prolonged postflight reaction was a profound disturbance in postural adaptation. Standing or even sitting was accompanied by symptoms of the vasodepressor type of reaction. The responses of 20 subjects tilting on a tilt table were studied 37 times before and 47 times after flight. Syncopal reactions were provoked 6 times by tilting after flight; in 5 instances there had been preceding syncope during flight, and in 3, postural maladaptation of the subjects was still demonstrable from two to seven hours later. It may be stated that postflight postural maladaptation may represent: (1) delayed recovery from vasodepressor syncopal reaction, (2) delayed reaction and severe decompression sickness, or (3) a combination of the two.

Vasodepressor reactions represent a reflex type of syncope, the cardinal feature of which is a fall in blood pressure. Tilt table and electroencephalographic studies indicate that most of the symptoms are secondary to the fall in arterial blood pressure.

The erect position seems to result in the pooling of blood in dependent portions of the body. The two major factors which may be responsible for this type of syncope are (1) afferent stimuli from various sites, such as the skin, muscles, periosteum, hollow viscera, serous membranes, and testes, and (2) psychological factors associated with threatening situations. The mechanism of the nondepressor reactions is not clear. Little is known about the mechanism of the prolonged postflight postural maladaptation that is occasionally observed.

The vasodepressor type is treated by lowering the head or assuming the recumbent position, but once the process is well established recompression is necessary. Recompression is the only procedure recommended for the nondepressor type of reaction. Since all of the prolonged postflight collapse reactions have occurred in subjects who have attempted to endure severe chokes, the importance of avoiding prolonged severe chokes is obvious.

The occurrence of syncopal reactions would seriously interfere with flying efficiency and must be considered a dangerous complication among flight personnel. It is pointed out that elimination of subjects susceptible to decompression sickness would automatically eliminate the great majority of syncopal reactions. LEROY J. KLEINSASSER, M.D.

GENERAL BACTERIAL, PROTOZOAN, AND PARASITIC INFECTIONS

Harper, G. J.: The Inhibition of Penicillin in Routine Culture Media. *Lancet*, Lond., 1943, 245: 569.

Accurate bacteriological studies of infected wounds treated locally with penicillin could not be made because of the contamination by this drug of the culture media from the wound swab. Although penicillin can be inactivated by strong chemicals such as sulfuric acid, and heat, such methods were not applicable to studies in wound infections. The author investigated therefore the action of penicillinase as an inactivator of penicillin for use in eliminating the inhibitory effect of the latter on bacteriological cultures.

Penicillinase was obtained from culture filtrates of penicillin-resistant bacteria and by a process of extraction from crushed bacteria. The paracolon bacillus supplied the greatest amount of penicillin inactivator and exhibited the highest degree of penicillinase activity. One milligram of penicillinase powder could inactivate 200 units of penicillin, and retained its activity even after five months of storage. Penicillinase was obtained also from bacterium coli, bacterium aerogenes, and the air micrococcus. In these studies the penicillinase was incorporated in the liquid and solid culture media. Swab cultures from penicillin-treated wounds showed no bacterial growth in the regular control media but yielded positive cultures in the penicillinase media. Blood cultures from patients with circulating penicillin were usually sterile while those which contained penicillinase permitted bacterial growth. The penicillinase effect was believed to be due to a neutralizing enzymatic action on penicillin which appeared as a contaminant in the culture medium or existed in the blood and inhibited the appearance of the bacterial flora. BENJAMIN G. P. SHAFIROFF, M.D.

PENICILLIN INHIBITION IN PLATING OF ROUTINE WOUND SWABS

No.	Before penicillin	After penicillin	
	Routine media	Routine media	Penicillinase media
1	+++ Staph. aureus	Sterile	+++ Staph. aureus
2	+++ Staph. aureus	Sterile	+++ Staph. aureus
3	+ Staph. aureus	Sterile	+ Staph. aureus
4	++ Staph. aureus	Sterile	++ Staph. aureus
5	+ Strep. pyogenes	Sterile	+ Strep. pyogenes
6	+++ Staph. aureus	Sterile	+++ Staph. aureus
7	++ Staph. aureus +++ Diphtheroids	Sterile	++ Staph. aureus +++ Diphtheroids
8	+++ Staph. aureus	Sterile	+++ Staph. aureus
9	+++ Staph. aureus ++ Strep. pyogenes	Sterile	+++ Staph. aureus ++ Strep. pyogenes
10	+++ Staph. aureus	Sterile	+++ Staph. aureus

DUCTLESS GLANDS

Lattimer, J. K., Engle, E. T., and Yeaw, R. C.: True Hermaphroditism. A Case Report, with Interpretations. *J. Urol.*, Balt., 1943, 50: 481.

An eleven-year-old negro child with hypospadias and no palpable testes was admitted to the Babies Hospital Service of the Squier Urological Clinic in New York City. Internally, an ovary was found on the left side and a testis was found on the right side at the ends of a broad ligament. Adjacent to the testis, and probably attached to it, was a tiny ovariotestis. The genital tract consisted of one large and one minute duct.

When the child was one month old, the mother noticed a tender mass in the right inguinal region, which appeared almost daily, and disappeared on pressure. The mass was assumed to be a testis, and at the age of seven years, at the hospital of his birth, the child was given a course of about 30 injections with no effect. The patient had experienced difficulty in urination, and prolonged dribbling.

The behavior of the patient had always been typically male. The mother had observed the phallus to be erect on 1 occasion, at the age of ten years. She had never observed any bloody spotting or evidence of nocturnal seminal emissions on the bed clothes.

On physical examination the child presented a preadolescent physique with no marked sexual differentiation, although the physical habitus was possibly more that of an eleven-year-old girl (Fig. 1). The face could have been that of either a male or female, as is frequently true of normal preadolescents

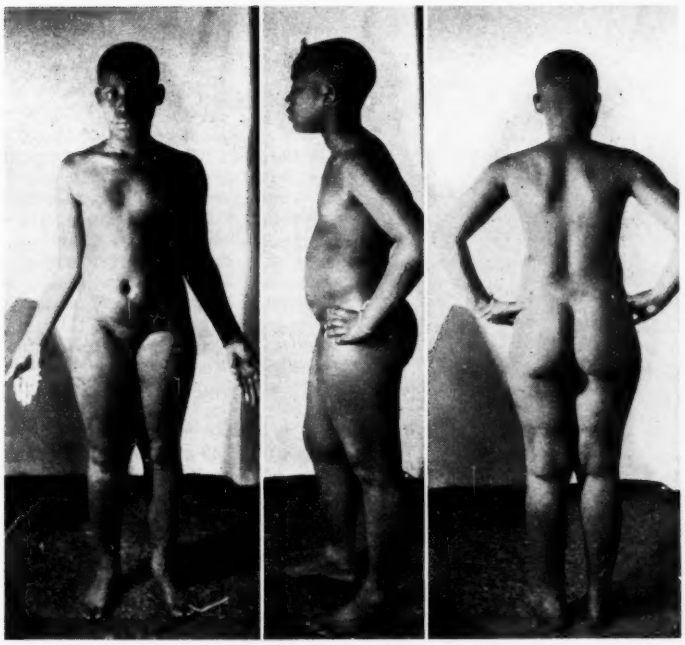

Fig. 1. Photographs of the eleven-year-old patient.

The supraorbital ridges were not prominent, but the Adam's apple was large. The voice was of medium timber. The figure was stocky (4 ft. 11 in.; 120 lbs.) with prominent mammary regions but small nipples. The thighs were heavy, with typical female fat distribution. The phallus was small and short and the glans was bound down in chordee. It was 1 in. in length and was encompassed at its base by 2 folds which resembled labia majora. The urine escaped through a hypospadic orifice at the base of the phallus. Continuous with this orifice was a groove which ran up the ventral surface of the phallus to its tip. A small, tender mass could be felt in the right inguinal canal, which was interpreted as a hernia. There was no evidence of a vaginal orifice externally and no testes could be palpated.

When contrast material was introduced into the urethral orifice with a catheter, the dye entered a long, tubular cul-de-sac connected with the urethra. During the taking of the intravenous pyelogram, urine leaked from the bladder and filled the cul-de-sac. The bony pelvis was more android then gynecoid. The bone age was not accelerated, as it is said to be in pseudohermaphroditism associated with adrenogenitalism. The sella turcica was normal.

A Butterfield children's cystoscope was easily introduced into the bladder by following the roof of the urethra. A normal bladder with a prominent, narrow trigone, suggestive of the male type, was seen. Upon withdrawal of the cystoscope into the urethra, a structure resembling a verumontanum was visible, about 3 cm. distal to the bladder neck. This showed a prominent sinus pocularis, and although the cystoscope could not be passed into this orifice, a ureteral catheter was passed to 10 cm. and contrast material was injected. X-ray films again showed the tubular cul-de-sac located beneath the bladder and extending into the pelvis. This cul-de-sac was deflected toward the right from the midline. An external urethral sphincter was seen, distal to the verumontanum. No prostate nor seminal vesicles could be palpated by rectal examination.

Laboratory examination showed that the androgen output in the urine was normal for a male of this age. The estrogen output was 5 rat units in twenty-four hours.

A suprapubic exposure (Fig. 2) revealed a complete broad ligament in the normal position. Just to the right of the center of the broad ligament was a thickened ridge or cord suggestive of a rudimentary uterus. A fimbriated fallopian tube was present in the normal position, on each side, and each appeared to be connected with the thickened cord within the broad ligament. A gonad was present on each side, in the positions normally occupied by the ovaries. The one on the right was globular and measured 1 by 1.5 cm. No structure resembling an epididymis or vas deferens could be distinguished grossly.

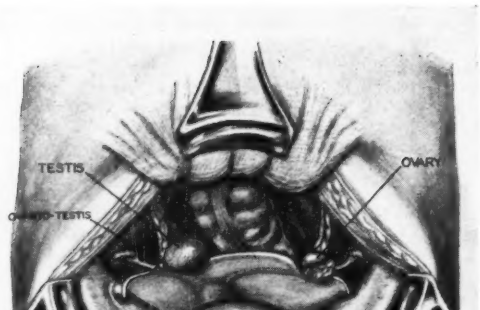

Fig. 2. A drawing of the pelvic viscera found at operation.

From each gonad, a thin, white, cordlike structure extended to the internal inguinal ring, where an indirect hernia was present.

Palpation of the adrenal areas revealed no tumor masses, and both kidneys were normally situated.

This child had always wanted to be a normal boy. He was brought up as a male, and his parents were anxious to have him continue as a male. His psychological and sociological adjustments were thoroughly masculine. This background was considered to be sufficient to justify the removal of the female structures. Therefore, the tubes, the left gonad (ovary), and the broad ligament, with the enclosed genital tract, were removed through a midline incision. The testis was mobilized and brought down through a right inguinal incision, into the fold of skin at the right side of the phallus. The hernia on the right side was then repaired.

The structure which later proved to be an ovariotestis was discovered when the testis was mobilized at this operation.

The specimens were fixed in Bouin's solution and blocks of the genital tract were prepared for study.

Microscopic examination revealed that the excised specimen from the right gonad had the characteristics of a testis of late childhood. It was covered with a thick tunica albuginea, with no marked area vasculosa. The seminiferous tubules were more sparsely distributed than is normal for an eleven-year-old boy. They were small, coiled, and each contained a definite lumen. Well differentiated Sertoli cells were abundant. The only other cellular component was the spermatogonia.

The specimen from the left gonad showed a normal ovarian cortex which contained large numbers of primordial ova, remnants of atretic follicles, and 1 follicle several millimeters in diameter which had been cut through at removal. The entire ovary, which was subsequently removed, was 17 mm. long and approximately 8 mm. thick. It had a thick cortical zone in which were a very large number of primordial follicles.

An additional case of true hermaphroditism is reported in an eleven-year-old negro child who showed hypospadias and no palpable testes.

A rudimentary ductus deferens, epididymis, and juvenile testis were found on the right side of the abdomen. Structures resembling prostatic corpora amylacea were found where the prostate should have been.

On the left side a rudimentary fused muellerian duct, a patent fallopian tube, and a prepubertal ovary were present. The müllerian system emptied into the posterior urethra.

In addition, there was a small ovariotestis and a remnant of a fallopian tube on the right side. The ovary and the duct systems were operatively removed and an orchidopexy was performed.

JOHN A. LOEF, M.D.

SURGICAL PATHOLOGY AND DIAGNOSIS

Woodard, H. Q.: Role of the Chemical Laboratory in the Diagnosis of Neoplastic Diseases of Bone. *Arch. Surg.*, 1943, 47: 368.

Confusion has existed regarding the significance of changes in the chemical composition of the blood and urine of patients with tumors of the bone. Several diseases of unrelated cause are capable of causing the same chemical abnormalities. If the mechanism of the chemical changes is understood, a consideration of the laboratory data will often establish a diagnosis which could not be made by clinical observation alone.

The metabolism of bone is discussed. The interpretation of laboratory methods is extremely important because it is necessary to know how large an experimental error may be expected and what conditions are likely to interfere with the correct determinations. The serum-phosphatase determination depends upon the measurement of the amount of decomposition which is produced in a phosphate ester under standard conditions. Systemic errors as large as 50 per cent may be made when the *p*H is not adequately controlled in the determination of alkaline phosphatase. For alkaline-phosphatase determination the serum may be kept overnight in the ice box, but for acid-phosphatase it is essential that the determination be made as promptly as possible. Normal values for alkaline phosphatase in adults are from 1.5 to 5.0 Bodansky units. For children the normal values of serum alkaline-phosphatase range from the upper adult normal value to three times this amount, according to the rate of growth. Normal values for acid phosphatase in adults are from 0 to 1.0 Bodansky unit per 100 cc. of serum.

Serum inorganic phosphate has normal fasting values for adults ranging between 2.5 and 4.0 mgm.

per 100 cc. Similar readings for children range between 4.0 and 6.0 mgm. per 100 cc. and may be even higher in infants.

The method of determining the total serum calcium is accurate to 1 per cent. Gross errors are possible in this determination through loss of precipitate or through the inadequate washing of the precipitate. Normal values for total serum calcium in the adult vary between 10.0 and 11.0 mgm. per 100 cc. Values between 11.0 and 12.0 are occasionally seen in healthy persons who have been exposed to the sun or who have been taking vitamin D. In an adult a serum calcium below 10.0 mgm. per 100 cc. is abnormal. In infants and children the figures average about 1 mgm. per 100 cc. higher than in adults.

The normal values for total serum protein usually lie between 6.3 and 8.0 gm. per 100 cc. The Bence-Jones protein-test result may be obscured by other urinary proteins as many patients with plasma-cell myeloma excrete this protein only intermittently or not at all.

DIFFERENTIAL DIAGNOSIS

The author has placed the conditions most often seen in children and young adults in one group and the conditions most frequently seen in middle-aged and elderly patients in a second group. The first group includes benign local overgrowths, solitary bone cysts, giant-cell tumors, osteogenic sarcoma, endothelioma of bone, and reticulum-cell sarcoma of bone. The second group includes metastatic cancer in bone and plasma-cell myeloma.

Primary tumors of bone. In children the value of serum calcium is slightly above the normal for adults, and the value of serum inorganic phosphorus is definitely above the adult normal. The amount of alkaline phosphatase in the serum varies with the rate of growth. In young patients, disease of the liver is uncommon and seldom needs to be considered in the interpretation of the phosphatase findings. In chondroma, osteochondroma, osteoma, and exostosis, all being characterized by the benign localized overgrowth of bony elements, the abnormal tissue contains about the same amount of alkaline phosphatase as normal bone. If an elevated alkaline phosphatase is encountered in these conditions a local malignant change is present in the bone, or disease of the bone is present elsewhere in the body.

Bone cysts. In solitary bone cysts of the long bones in children there is no change in the chemical composition of the blood, but hyperparathyroidism shows definite changes in the chemical values.

Giant-cell tumor. The alkaline serum phosphatase of patients with benign giant-cell tumors is usually in the average normal range. The serum-calcium and phosphorus values are normal. In the author's experience, whenever the value of serum alkaline phosphatase of patients with giant-cell tumors has been definitely above normal (from 6 to 9 Bodansky units) the tumors showed aggressive tendencies or were frankly malignant. The presence of normal amounts of alkaline phosphatase in the serum does not prove that the tumor is benign.

Osteogenic sarcoma. There is no definite correlation between the phosphatase activity and the histological type of this growth. In general, the greater the formation of new bone the greater the phosphatase activity. In roentgen irradiation of osteogenic sarcoma with a dosage equal to or exceeding 4,000 roentgens, the phosphatase-producing mechanism is nearly always completely inactivated. Resumption of tumor growth is accomplished by resumption of the production of phosphatase. A large amount of alkaline phosphatase in the serum always indicates that the tumor is rather active. The values for calcium and phosphorus in the serum of patients with osteogenic sarcoma are normal. The absence of a rise does not preclude the presence of metastases.

Endothelioma of bone; Ewing's tumor. Small elevations in alkaline phosphatase may be detected in adults, but in children variability of the normal values is found. Ewing's tumor causes no change in the values of serum calcium and phosphorus.

Reticulum-cell sarcoma of bone. Chemical studies are of no help in distinguishing this tumor from endothelioma or inflammatory disease of the bone.

Rickets. A young patient with a tumor of the bone may also have rickets. Rickets and the different bone diseases should not be confused.

Inflammatory disease of bone. There are no conspicuous changes in the amounts of serum calcium and phosphorus in this condition.

Metastatic cancer in bone. The alkaline phosphatase produced by bones which are the site of carcinoma metastases apparently enters the circulation readily, and there is usually a close correlation between the two processes. At the Memorial Hospital about 80 per cent of the patients with metastases of the bones from cancer in organs other than the prostate had predominantly osteolytic metastases. In contrast to this, 75 per cent of the metastases to the bone in carcinoma of the prostate were almost wholly osteoplastic and nearly all the remainder showed some degree of formation of new bone. With the sole exception of metastatic cancer of the prostate, the site of origin of the cancer which metastasizes in bone cannot be determined by chemical means. Chemical examination of the blood and urine often gives valuable information as to the existence and activity of metastases in bone.

A review of the blood chemistry of 250 cases with no bone metastases shows that in about three-fourths of them an increased amount of calcium, phosphorus, or alkaline phosphatase was present. An increase in serum acid phosphatase is considered pathognomonic of metastasizing carcinoma of the prostate. A prompt drop in the value of serum acid phosphatase after the institution of endocrine treatment shows that a favorable clinical response may be anticipated.

Plasma-cell myeloma. The distinguishing chemical change in this condition is in the protein constituents of the blood and urine. About 60 per cent of the

patients with plasma-cell myeloma excrete Bence-Jones protein in the urine at some time during their illness. Osteomalacia and senile osteoporosis may be confused with neoplastic disease of the bone.

Hyperparathyroidism. This condition is due to the increase in the serum calcium and the lowering of the renal threshold for phosphorus which is brought about by excess parathyroid hormone. Both of these conditions result in the loss of large amounts of calcium and phosphorus in the urine with corresponding depletion of the stores in the bones. The typical patient with hyperparathyroidism shows a high value for serum calcium, a low value for serum inorganic phosphorus, a high value for serum alkaline phosphatase, and a pronounced reaction to the Sulkowitch test. The disease exhibits many confusing variations.

Osteitis deformans. The amounts of calcium, phosphorus, and acid phosphatase in the serum are normal and the value of alkaline phosphatase is greatly elevated in this condition. If the amount of both the acid and alkaline phosphatase in the patient's serum is above normal he has metastasizing carcinoma of the prostate.

There is a large table summarizing the chemical findings in typical cases of various neoplastic and non-neoplastic diseases of bone which are the most likely to be confused.

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EXPERIMENTAL SURGERY

Blackwood, W., and Russell, H.: Experiments in the Study of Immersion Foot. *Edinburgh M. J.*, 1943, 50: 385.

With the tail of the rat as an experimental limb, a histological study was made of the changes which occurred after periods of exposure to cold and wet. The periods and conditions of exposure were comparable with those under which the less severe forms of immersion foot develop in man. No exposure of longer than ninety-six hours was made. Gangrene was, therefore, not seen.

Under the conditions of the experiment, much the most vulnerable tissues were the muscles and nerves. They were conspicuously damaged after exposures of forty-eight hours and more seriously damaged after longer exposures. The skin and other tissues, including the blood vessels, appeared much more resistant to chilling. In animals destroyed two months after exposure, the nerve and muscle tissue had not returned to normal, and in rats surviving sixty days some evidence appeared that muscle degeneration secondary to denervation was setting in. Investigation as regards treatment in the form of two heating-up processes revealed an acceleration of the initial reaction but showed no significant difference in the histological changes in a month's time.

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Golden, R. F., and Mann, F. C.: The Effects of Drugs Used in Anesthesiology on the Tone and Motility of the Small Intestine: An Experimental Study. *Anesthesiology*, 1943, 4: 577.

This article presents a comparative experimental study of the effect of anesthetic agents and combinations of agents on the tone and motility of the small intestine. The study was made on dogs that had permanent exteriorized loops of bowel (ileum and jejunum) in continuity, sheathed in a sleeve of skin graft.

Careful observation of the normal intestinal activity was made in order to obtain adequate controls.

Morphine produced a transitory increase of intestinal activity followed by a depression which was more extensive than that produced by any other agent studied.

All of the agents except those used for spinal anesthesia were found to have either a depressing effect or no effect on the tone and motility of the loops of the intestines observed. Spinal anesthesia produced increased activity as long as the anesthesia substance was effective.

Atropine when used alone was found to be a depressant.

In general, more depression resulted from the use of preanesthetic drugs than from any other anesthetic agent regardless of the depth or duration of the anesthesia. The depth of anesthesia is probably more important than the duration in the production of the depression of any intestinal activity.

Trauma plays a more important role than any other specific factor in the production of depression. The rate of administration of pentothal was found to be an important factor in regard to the amount of depression of intestinal motility produced by this substance, a more rapid administration causing greater depression.

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